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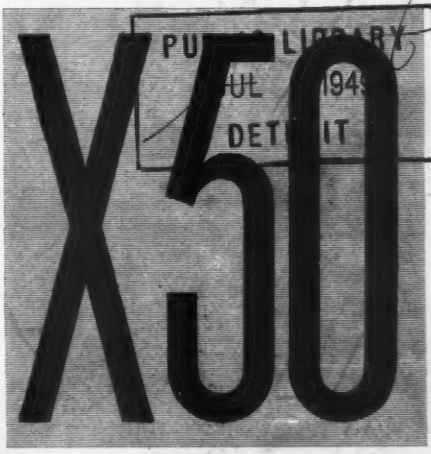

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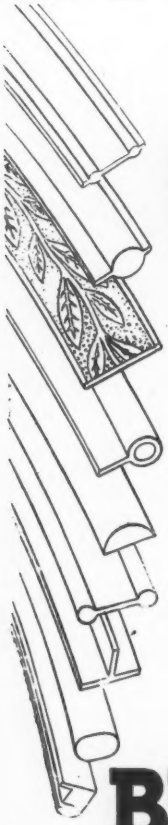

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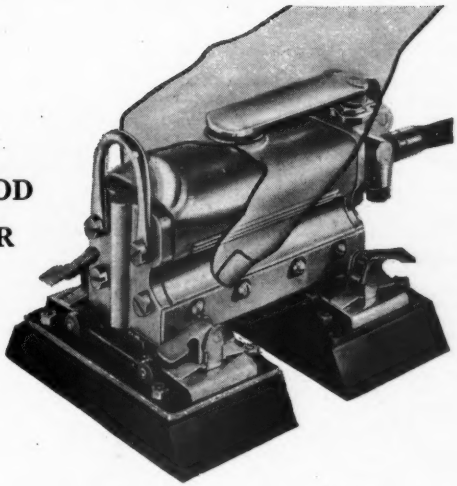

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Page 600

No. 2 Ball and Jewell rotary cutter, 27-in. long by 16-in. diam., direct coupled 65 b.h.p. S/R motor by L.D.C., 415/3/50, speed 970 r.p.m., with starter, cutter 6-ft. 2-in. long, motor 3-ft. long. This machine of heavy construction and suitable for rubber and plastics.

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Several 80-ton upstroke hyd. presses by Bradley and Turton, each having 10-in. diam. glanded ram by 12-in. stroke, four screwed cols. 2¾-in. diam. with 18¼-in. by 9¼-in. between, and fully guided table 18-in. by 17-in. with a pair of C.I. electric platens 17-in. sq. each having 5 elements and temperature control by Teddington instruments. Daylight, table to head 18-in./24-in. adjustable, between platens 12-in./16-in., main ram and table returned by a pair of 1½-in. diam. push back rams. Complete with pressure gauge W.P. 1 ton per sq. in.

50-ton vert. downstroke hyd. press by Bradley and Turton, main ram 8-in. diam. by 8-in. stroke, two push back rams each 2-in. diam. mounted on press base and attached to moving table, four steel cols. 2-in. diam. with distance between of 15-in./16-in., daylight, fixed to moving table 19-in. Mechanical ejector gear is provided. Press is operated by Bradley and Turton variable delivery pump, capacity 1 g.p.m. up to 1 ton per sq. in. pump arranged for motor drive through Vee ropes, 2 h.p. required to drive at 750 r.p.m., complete with prefilling valve, interconnecting piping and control valve.

50-ton vert. downstroke hyd. press by T. H. and J. Daniels, main ram 8-in. diam. by 12-in. stroke, four steel cols. giving a distance between of 14½-in. by 9½-in. fitted with fully guided moving table. Press arranged with two side pull-back rams, complete with one pair of new electric platens 14 ins. sq., having thermostatic control, daylight between platens 20-in., ejector cylinder and ram complete with crosshead is mounted on baseplate, has a power of 5 tons and a stroke of 4-in. Press is operated by a new S.P.LM.14 Electraulic pump direct driven through flexible coupling by 1½ h.p. motor, 380/440-3-50, speed 1,400 r.p.m., with starter. Valves and supply tank included. Immediate delivery.

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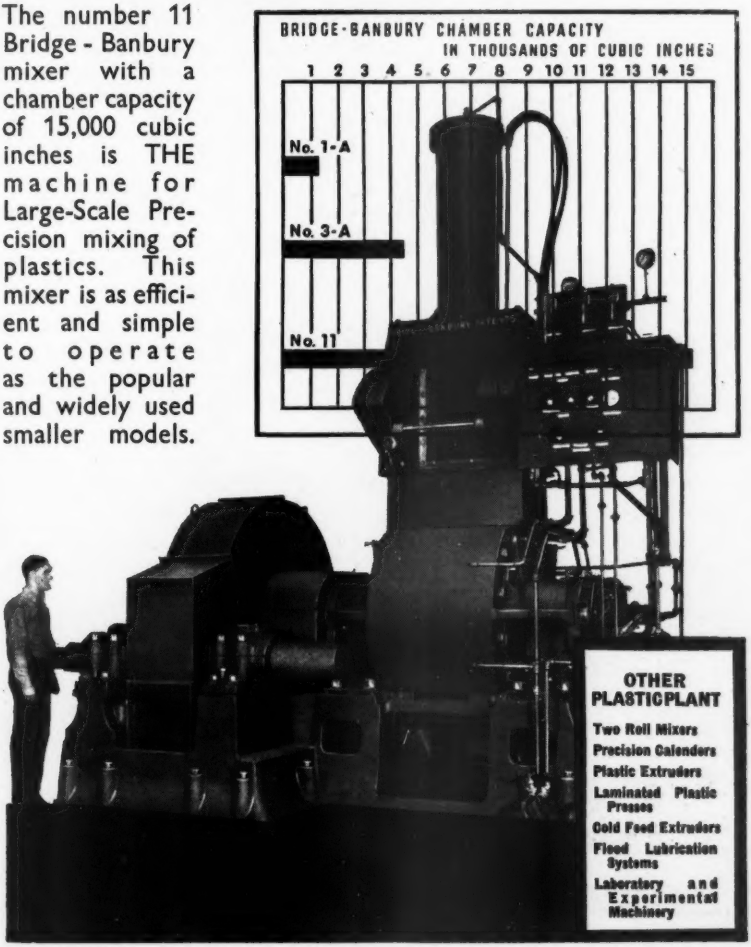

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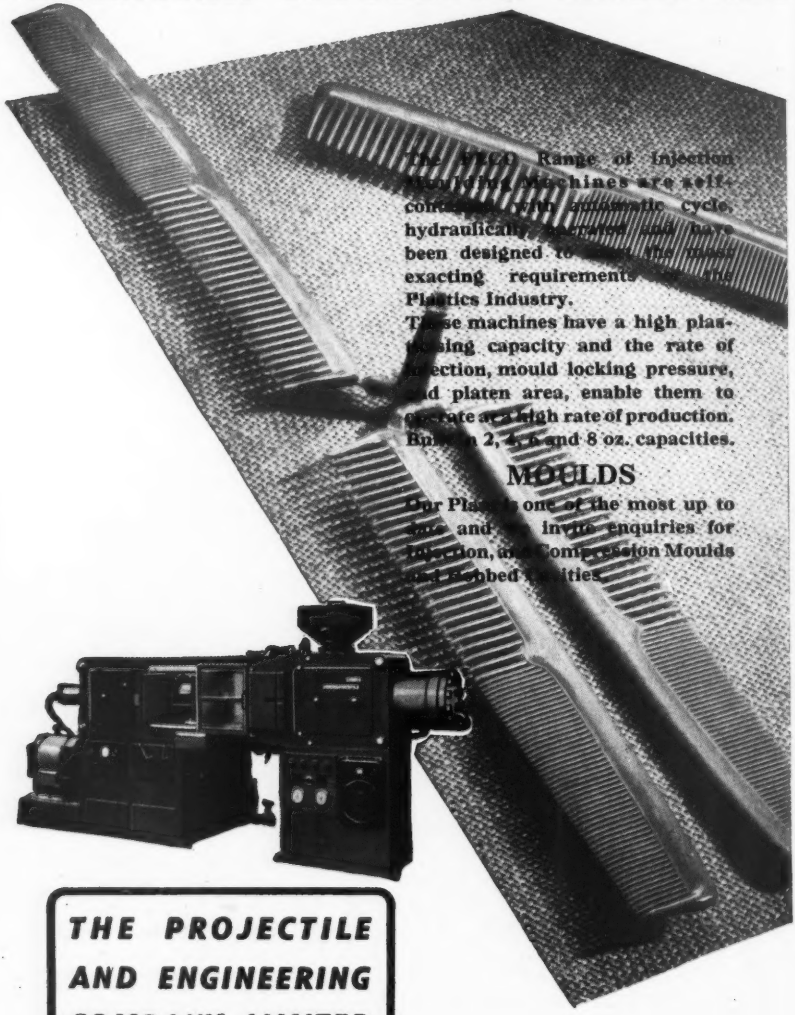

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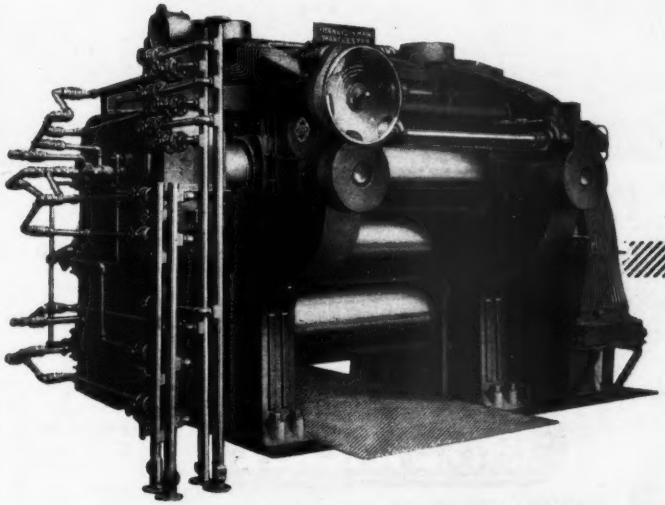

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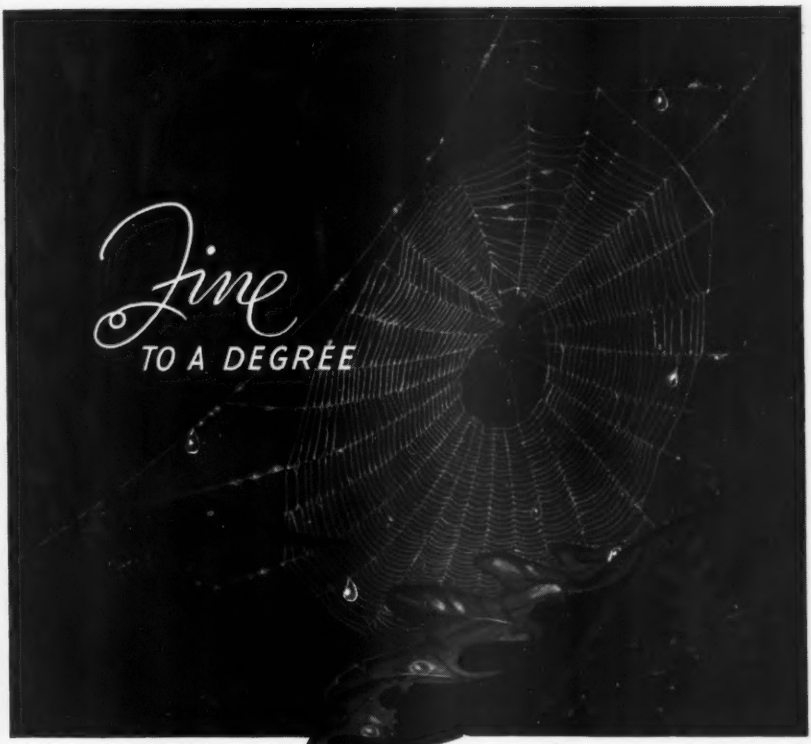

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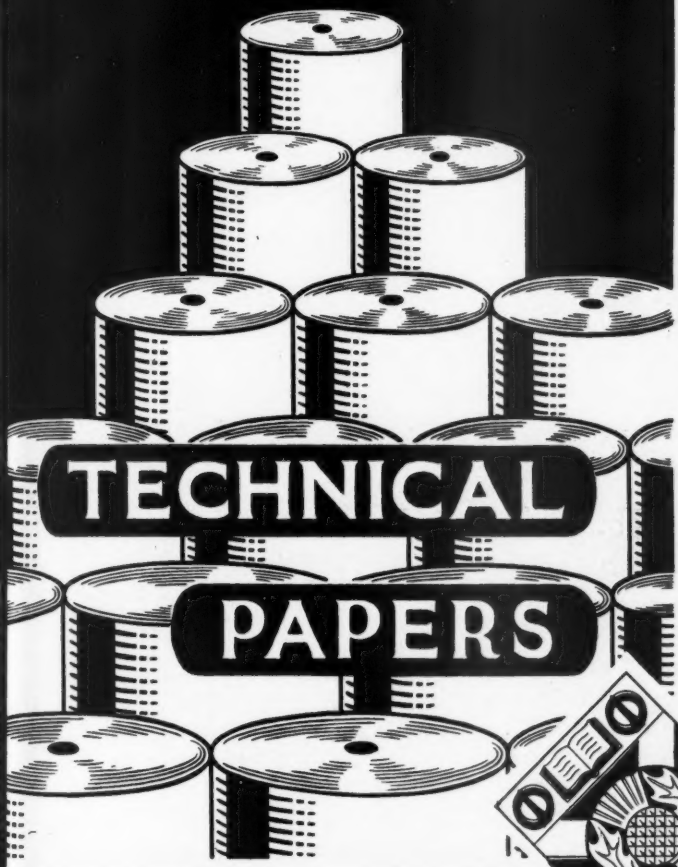

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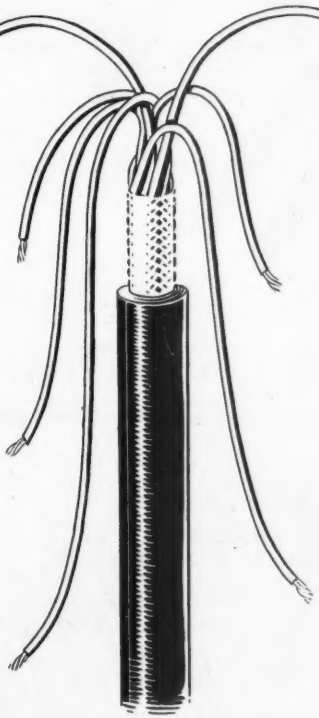

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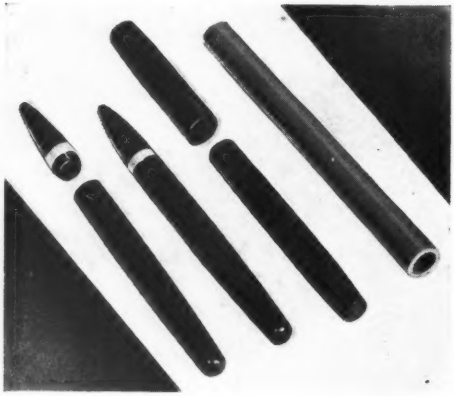

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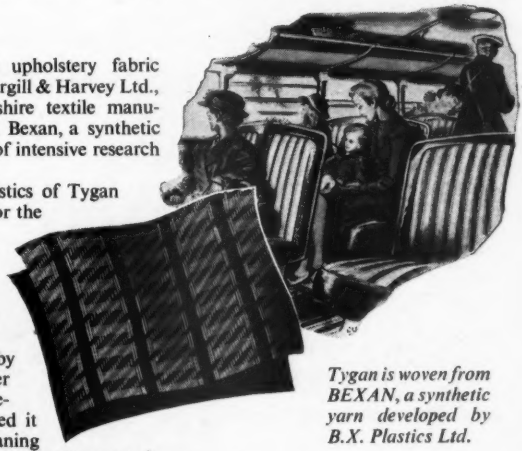

Tygan is woven from BEXAN, a synthetic yarn developed by B.X. Plastics Ltd.

Tygan is produced by Fothergill & Harvey Ltd. This is an assurance of the highest attainable quality and serviceability, which conform in every respect to the best standards of Lancashire woven productions.

● This is one of the advertisements for Tygan appearing in the Transport Trade Press.

Write for illustrated folder with patterns, quoting reference Z 7, to FOTHERGILL & HARVEY LTD., Harvester House, Peter St., Manchester 2

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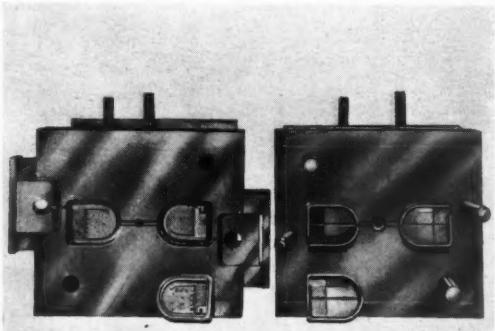

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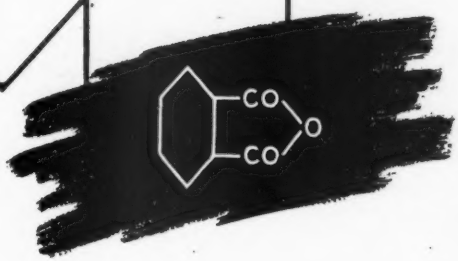

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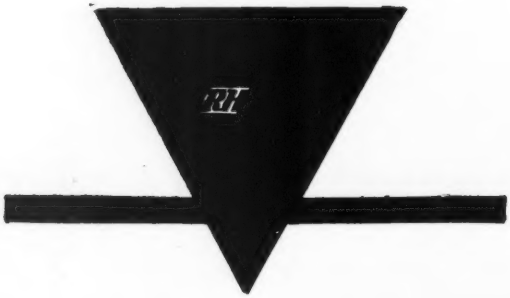

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The **RIGHT** Plastic
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A FEW EXAMPLES OF

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by LACRINOID

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Tensile strength Direction A Direction B	lb. sq. in. 29,000 19,000
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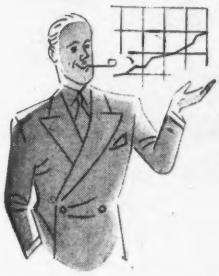

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LII

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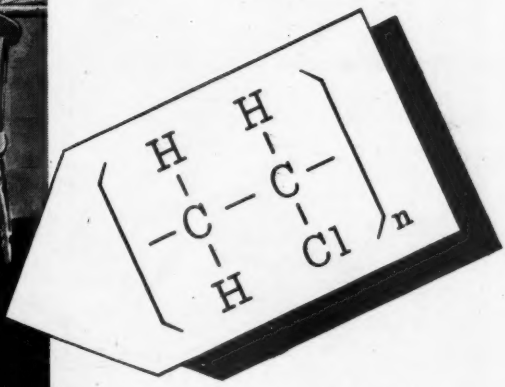

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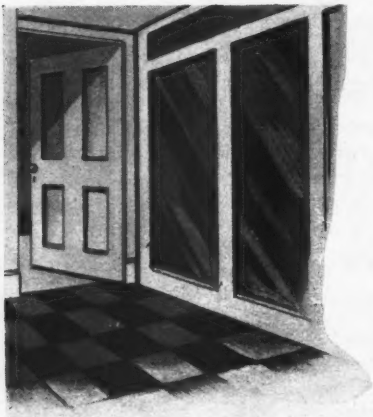

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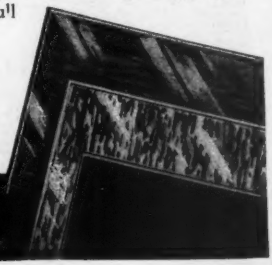

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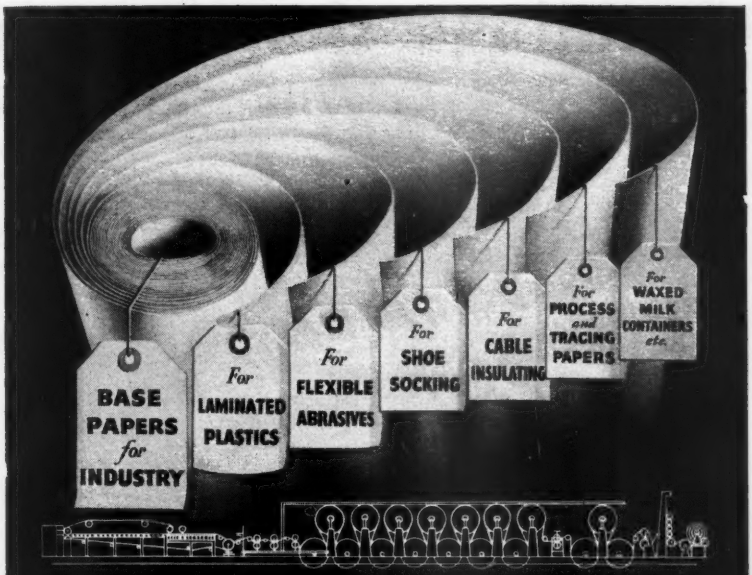

Here are a few of the special base papers we make for industry. Nearly 200 years of papermaking experience together with extensive modern research and control are behind these and many other papers. This experience and knowledge assure the high quality and regularity of our papers. The good name of your product, whether it be Abrasive Sheet, Milk Container, or Laminated Plastic, relies on the base paper. Although paper is scarce, let us begin research for you now so that when raw materials are more plentiful we shall be ready to give you just what you require for your especial needs.

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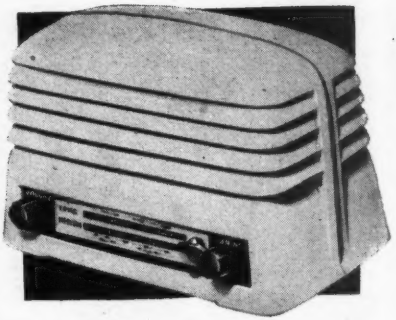

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PROPRIETORS: KOLSTER BRANDES LIMITED

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An old Indian word meaning, ' the land of waters ' is the origin of the name Guiana —an apt description enough of a country which is intersected by numerous rivers. The most spectacular feature of the inland waterways of British Guiana is undoubtedly the Kaieteur Falls on the river Potaro, where the river plunges headlong into a fertile valley down a sheer vertical drop of 740 feet. In the industrial sphere the interior of British Guiana can show little to match such natural marvels, for it has yet to see the day when the rivers are harnessed for power and its resources of minerals and timber are exploited to the full. In contrast the coastal areas have long been intensively cultivated and the crops they produce—which include the famous Demerara sugar—make an important contribution to the prosperity of the Colony.

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HEAD OFFICE: 54 LOMBARD STREET, LONDON, E.C.3

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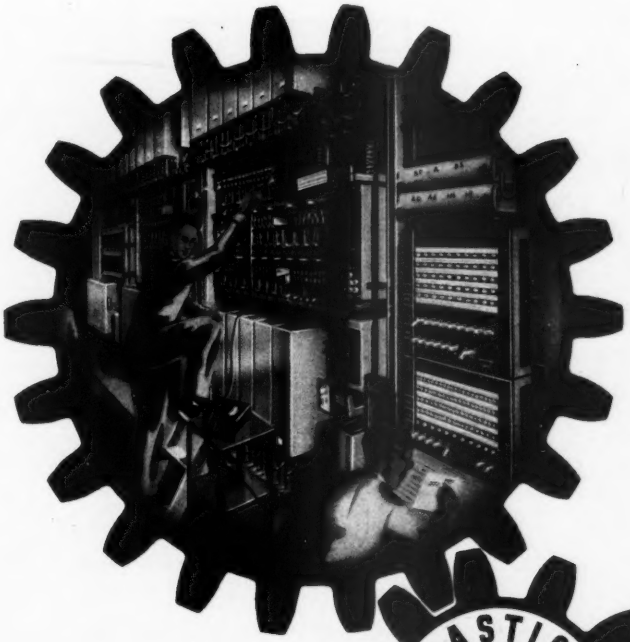

Mouldings and moulding powders. Resins solid, powdered or in solution. Insulating varnishes. Cements and lacquers. Anti-friction resins for fabric bearings. Casting resins. Capping cements. Paint resins. Filling compounds. Sealing fluids.

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ELECTRICAL INDUSTRY

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TEMPERATURE CONTROL

of

MOULDING PRESSES

THIS CAMBRIDGE THERMOMETER REGULATOR is specifically designed for plastics moulding presses, and is easy to fix, reliable in action over long periods, inexpensive and exceptionally robust.

STANDARDISED EQUIPMENT on many well-known makes.

SPECIFICATION:
Range: 250°—400° F.
or 120°—200° C.
with 6 ft. capillary tubing, bulb with swivel connection.

Details are given in **SHEET No. 276-P.** May we send a copy?

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WORKS: LONDON & CAMBRIDGE

Makers also of **SURFACE PYROMETERS** for Plastic Moulds.

Vol. XIII. No. 145. JUNE, 1949

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Chairman and Managing Director ROLAND E. DANGERFIELD

Editor - - - M. D. CURWEN, B.Sc., A.R.I.C.
Offices - - Bowling Green Lane, London, E.C.1

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NOTICES

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"The mantis is a curiously uncanny-looking insect. . . . She apparently produces a substance rather like white of egg, which she whips up as we do white of egg, and produces something akin to an omelette of soap-suds. This hardens in a few minutes and forms a protective covering for the eggs which are deposited in the froth. Unlike many insects, the mantis, having constructed one of these remarkable weatherproof cradles for her young, merely leaves this lying about in the open, anywhere, just where she happens to be, and walks off without taking any further interest in the future of cradle, babies and all. But, thanks to her innate skill in house construction, the eggs can survive the cold of winter without risk."

From: C. N. Buzzard, "Shining Hours," 1946 (Collins).

EDITORIALS

. . . Cauldron Bubble

THE plastics industry, like a goodly proportion of the British public in general, has read the "Sunday Express" of May 15. If they do not normally read it, that particular issue has certainly been brought to their notice. Mr. Bernard Harris has written two columns in it under what is called a banner heading entitled "The Plastic Bubble Bursts," describing the recent economic worries of our industry. Judging from the size of the heading, and its blackness, no doubt readers imagined that a disaster equivalent to the bursting of the South Sea Bubble had struck the country.

However, Mr. Harris's article, apart from its gruesome title, is by no means unfair and if the aforesaid title has frightened off the potential cheap-jack companies and the spivs of the world, and presuming also that it has not frightened off entirely the more sensible investor in industry, we shall be content.

We have said that the article is not unfair and, indeed, it attempts a balance, but we do wish the writer's knowledge of the industry had been more intimate.

After describing at considerable length the financial ups and downs of certain companies, he points to the troubles of the "new" industry as being due to over-optimism, over-expansion, price-cutting and, in some instances, to the sacrifice of quality for quantity. Export business is becoming more difficult and demand at home affected by tightness of money. There was also a flood of shoddy goods.

All this is in whole or part, true. But if we are not quite lunatics it was and is still true of almost every industry.

The steel industry is sound enough, but who has not, in the war years and since, bought a tin opener that buckled on the first attempt to open a tin of salmon. The coal industry is sound, but our dealer insists on supplying us with 2 cwt. of iron sulphide and slate in every ton. The furniture trade is sound, but is it only rumour that tells us that some furniture has been made from three-ply or soap boxes. Sackville Street and Saville Row still stand where they did, but a lot of shoddy stuff has been sold during the last 100 years. And although the crockery industry is still so sound, has Mr. Harris or his wife never bought during the last few years a cup and saucer for 2s. 6d. to 3s. 6d., of such wretched quality that must have made Arnold Bennett turn in his grave and the Five Towns blush with shame?

Mr. Harris writes: "People began to talk of the approaching "Plastics" age which would replace the age of metals. . . . They foresaw the time when motor-car bodies, aircraft fuselages, even small ships, would be moulded in one piece from plastics. . . . One optimist described

the coming paradise when "everybody will be sitting on plastic chairs, sleeping on plastic beds, eating food from plastic dishes, set on plastic tables."

This wild talk was certainly not fostered by the plastics industry. The warning was uttered in these pages, before and during the war, that plastics were not the panacea for all industrial ills. National publicity, especially by British Industrial Plastics, Ltd., Bakelite, Ltd., and I.C.I., Ltd., did its best to put plastics in their proper spheres.

"People," whoever this refers to, did, of course, speak as Mr. Harris says they did. What is more to the point is that certain daily papers and weeklies seized upon the plastics industry and splashed and splurged their pages with what highly coloured and exaggerated fantasies and romances they could squeeze from occasional isolated facts and truths which were possible on limited scales. If we published a note on the fact that small dinghies of laminates were being made during the war, as sure as fate a Fleet Street man would ring us up and ask why White Star liners could not be so made. And when we published the story of Ford's experimental car, did not we think that all cars would be made from moulding powder? When a dog bites a man, it is no news. A good many news-hounds are continually searching for, and finding, the man who has bitten a dog.

The plastics industry is like most others. Its products, born of chemistry and engineering, cannot replace all traditional materials all the time although they enter into all industries.

But the plastics bubble will burst only when the G.P.O. gives up making telephones and using wires and cables, when the G.E.C., E.E.C., B.T.-H., Marconi's, Ferranti's, Pye's, and the dozen others, find a non-plastic for their insulators, when Gillette's give up plastic containers for their razors, when Hoover's stop using plastics somewhere in their machines, when Ford, Hillman, Rolls-Royce, Austin, and all the others, stop using plastics for their accumulator cases and at a dozen or more points in their cars, when Guest, Keen and Nettlefolds give an adverse report on synthetic bearings on their continuous billet mill, when it is declared that the famous "Mosquito" of war-time memory was a failure, when ocean liner builders say their walls, table tops and bar tops of decorative laminates are dropping to bits, when the children of the world revolt against their plastics toys, and when pretty girls refuse to accept gift nylons.

We are grateful to Mr. Harris for telling his readers that there are some 20 different plastics and that they should all be used in their proper sphere. This should have been done five or ten years ago. What a lot of trouble and recrimination would have been avoided if we had been helped in an intelligent manner!

It remains to stop blowing bubbles.

The Nature of Plastics

Bakelite, Ltd., continues the very commendable pursuit of the ideal method of teaching the layman and students in technical and other institutions, what plastics are and what they mean to the world, through the cinema.

The latest film which Bakelite, Ltd., sponsors is entitled "The Nature of Plastics" and will serve as an introductory to others which will tell the main story of their properties and applications.

In 1946 we criticized a film made by the British Council, entitled "Plastics," the first and poorest. We then noted: "It cannot be overwhelmingly difficult to describe in pictorial form the formation of large organic molecules . . ." To our delight the new "Bakelite" film, which we have recently seen, is tackled in this manner and the "dance" of the molecules and their combinations from simple units to complex cross-linked thermosetting resins on the one hand, and to linear chains of thermoplastics on the other, is wholly enchanting as well as completely educational. We congratulate the company on a very difficult job, very well done. It was produced by Merton Park Studios, Ltd., who also deserve the highest of praise.

MOULDING POWDER AND SHOT

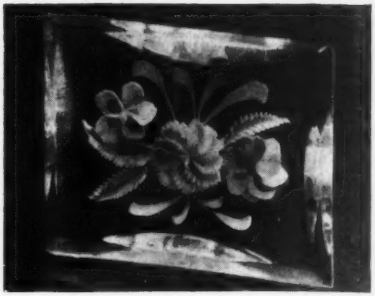
A-blowin' and A-growin'

At the Chelsea Flower Show last month I saw some of the new cheap potting "pots" now on the market—they are going down very well indeed. The varnished or otherwise impregnated paper type is already well known, but very new to me were those made from whale hide. The "pots" are cleverly cut from the sheet, base included, and folded and cemented down. Even stronger jobs could be made from the "Hycar" impregnated Kraft paper I saw on the British Geon stand at the B.I.F. I have not given up hope of seeing the type of phenolic and urea plastics used more extensively. They appeared more than 12 years ago. The truly unbreakable one of polythene, with its colour possibilities, seems, on the face of it, a cinch; it would be just the time to bring some out for the high-class trade, now that the earthenware type is so expensive and that simple polythene mouldings are reasonable in price. The attraction of low weight is important and they would really last for ever. Porosity is obviously not so important as it was first thought, but in any case a few fine holes could be drilled at selected points.

* * *

Cutlery Handles

Part of the art of selling, lies, not surprisingly, in knowing what the customer wants. This truth, it appears, has been discovered by the Sheffield cutlers on visit to Canada, where plain-handled knives are not much attraction to housewives, especially the young ones. They prefer handles decorated with sentimental inscriptions; in fact, "roses, roses, all the way"—especially as bridal presents; and why shouldn't they? The plastics industry could certainly start a new fashion, if it had the courage, by making the handles of transparent acrylics decorated on the reverse by what might be called the dentist's drill technique. This has greatly improved



and is a delightful art with lovely effects. The latest sample I have received (see photograph) is from The Crescent Studios, Chapel-en-le-Frith, Stockport, the roses and leaves being coloured. The serrated edges of the latter are magnificently executed. With this transparent plastic, the "tail" must be hidden, I presume, with opaque plastic, to which the decorated portions could be cemented or otherwise fixed. Not a cheap job, I suppose, but then, lovely jobs never are.

* * *

Bringing up Baby

Two American ladies at our B.I.F. stand wanted to know where plastic "play-pens" for children were on sale. They had seen an announcement in an English newspaper saying they were ultra-light and were on view at the B.I.F. I inquired at two extruders of acetate tubing, presuming that the bars would be made of plastics, but nothing was known. Miss Weston, of Treasure Cot Co., Ltd., Oxford Street, London, who ought to know, said there was none and they themselves used only a p.v.c. groundsheet for their play-pens. There's one thing certain about these young hopefuls, so great is their strength and determination to commit novel forms of hara-kiri, that it is either a question of plastic-coated metal tubes or perhaps a colourful network of p.v.-covered wire.

DOGSBODDY.

This photograph of an induction heated platen made by B.I.P. Tools Ltd., illustrates how the induction heating coils are incorporated.

Two New Developments for Moulders and Mould Makers

WE have already referred briefly ("Plastics," April, 1949, page 197) to two new developments by B.I.P. Tools, Ltd., which were shown publicly for the first time at the Birmingham Section of the B.I.F. As both are of outstanding importance to moulders and mould makers, we take this early opportunity of dealing with them in greater detail.

Induction Heating for Improved Heat Distribution

The application of controlled heat—an essential factor in the efficient working of a moulding tool—has for many years been treated as a necessary evil rather than a contributory factor towards the production of first-class plastics mouldings.

Random application of heat to a plastic moulding tool is comparable to bad tool design or finish, and conducive to poor results. Although some moulding materials offer much more latitude to heat fluctuation and inconsistency than others, there is no case for "hit-and-miss" methods with existing hot plates, such as evidence suggests are often employed.

The nearest other approach to efficiently planned heating of moulding tools has been the incorporation of resistance-type heating elements, with thermostatic control to achieve constant temperature. It is a well-known fact, however, that a resistance heater develops a temperature far in excess of that to which the tool must be raised, and once the elements become energized a hot spot develops in their immediate vicinity, from which conduction takes place to provide general heat.

Although a thermostat in the body of the mould will react when the predetermined temperature is reached, a temperature rise will still continue after the break, due to the heat reserve stored in the metal surrounding the heater. In addition, it will be readily appreciated that the displacement of the heaters and thermocouple becomes a very difficult problem in relation to the maintenance of uniformity and consistency of surface temperature.

B.I.P. Tools, Ltd., has now worked along the lines of applying a source of heat very much nearer to the working temperature of the tool in order to reduce the violence of fluctuation which is experienced with resistance heating. This immediately raised the problems of how to retain the speed of heating up, whilst using less intensity of heat at the source, and how to improve the distribution of heat to eliminate periodic hot spots.

The development of heat within the actual steel provided the answer; the principle, already embodied in every transformer, was already proven and it only remained to develop it to suit the application.

Tests suggest that the B.I.P. Tools method of heating moulds by the induction principle represents the greatest advance yet made in mould heating technique. Heating-up time is shortened. A surface pyrometer check shows no appreciable fluctuation as the thermostat comes into operation. A general check shows a greatly improved consistency of temperature. A further important advantage is that the heating coils are much more robust than the delicate resistance heater filaments; as the coils only reach a temperature of approximately 260 degrees C. the chances of failure are very remote.

Induction heating coils can now be embodied in all moulding tools made by B.I.P. Tools, Ltd. With characteristic thoroughness the company has not rested content with the development of the heating method but has designed a special test panel to ensure that every induction-heated tool which leaves the works is working satisfactorily.

Moulds and Mould Parts Made by Precision Casting

Precision casting of moulds and mould parts is now an accomplished process in the plastics tool-making industry, due to developments pioneered by B.I.P. Tools, Ltd. Considering the possible versatility of this process, however, it is as well to dispel any false impressions that it can supersede all existing machine tool work,

This precision cast die for moulding a doll's head is probably the largest plastics die ever to be precision cast in alloy steel in this country. The wax impression shown alongside it was taken direct from the die before any finishing operations had been carried out, and shows the faithful detail which can be quickly and accurately reproduced by precision casting as developed by B.I.P. Tools Ltd.

for this is not possible. Nevertheless, just as a new machine tool will execute a certain class of work more economically than one previously employed, so is precision casting taking its place as a production process.

Advantages are numerous and important. The class of material from which a mould was to be made has, in the past, been dictated often by the machining or other forming operations which had to be carried out: in such cases moulders often had to accept tools made from material eminently suited to the mould maker, but not necessarily to themselves. Precision casting removes such limitations. An almost limitless variety of materials can be accurately cast. No longer need delicate cutting tools be employed to cut intricate detail, or laborious hand cutting to achieve artistic impression; instead, a wealth of fine detail can be duplicated accurately and swiftly any number of times.

The word "cast" has become so closely associated in the past with a rough and vaguely formed contour that it is necessary to correct any such implication that the word may convey in relation to "precision" casting. Throughout the process, from the making of the model to the finished cast product, very careful control is maintained over both surface finish and size, resulting in a matt finish, perfectly formed component. The detail and quality of surface achieved minimize the work required for finishing, and the finished pieces stand comparison with any made by traditional machining methods. Summing up, the advantages are:—

(1) Almost unlimited choice of material ensures that the moulder obtains that most suited to his purpose.

(2) Accurate and economical reproduction of identical pieces, shows a great saving in time.

(3) Further time-saving is effected by accuracy of casting, and quality of surface.

(4) Finished parts in every respect are comparable to those made by traditional methods.

New premises, adjoining its present toolroom, have been acquired by B.I.P. Tools, Ltd., for casting moulds in production quantities by this process.

Electrical Insulating Materials

TWO more of the series of British Standards for moulded electrical insulating materials have now been published. These are B.S. 1539, "Moulded electrical insulating materials for use at high temperatures," and B.S. 1540, "Moulded electrical insulating materials for use at radio frequencies."

These standards are intended mainly to assist designers of electrical equipment. Each standard takes into account all the types of material that meet the requirements of the branch of electrical work with which it deals and this series of standards provides, as far as possible, similar methods of test to permit comparison of technical data.

B.S. 1539 deals with moulded electrical insulating material for use where temperatures may exceed 180 degrees C. It defines three broad classes of material: (1) Arc-resisting; (2) non-ignitable; (3) self-extinguishing. The standard specifies requirements for the electrical and mechanical properties of each of these classes, together with standard methods of test for these properties.

B.S. 1540 covers moulded electrical insulating materials for use under working conditions where they may be subjected to alternating electric fields having a frequency greater than 10,000 cycles per second. While the standard nominally covers only moulded materials, it may be applied by agreement to all the extruded materials as well. This standard, which is necessarily of some length, deals with six classes of materials—fused silica, vitreous materials, ceramic materials for insulators, ceramic materials for dielectrics, rubber-base materials, and synthetic resins. The standard specifies requirements for the electrical and mechanical strength of each of these classes of material.

Copies of these new standards can be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, London, S.W.1. B.S. 1539, price 3s. post free, B.S. 1540 price 5s. post free.

Cellulose Acetate Tubing for Insulation Purposes

By I. H. Child,
B.Sc. (Eng.), A.M.I.E.E.

THE increasing tendency for live parts in electrical switchgear to be protected against accidental contact, short-circuiting by vermin and similar hazards, has led to new uses of cellulose acetate tubing.

On low voltage and medium voltage industrial metal-clad switchboards it is frequently stipulated that the busbars and connections thereto shall be insulated instead of being merely air-spaced within the metal casings. Furthermore, joints require covering and various components require shrouding against possible contact by stray arcs.

Many of these problems have been solved by the use of standard types of tubing formed into required shapes by simple tools and processes, advantage being taken of the high extension possible when the material is in its softened state.

Cellulose acetate tubing has other desirable features from the switchgear manufacturer's point of view. Purchased in standard diameters and lengths, and of a fixed thickness, it is not expensive. It carries a pleasing finish, and can be readily polished. The process of softening and assembly is not lengthy, and does not call for a high degree of skill.

The electrical characteristic requirements of any such insulation are simple:

(i) Breakdown voltage should be suitable for the normal high-voltage test for the switchgear.

(ii) Conditions of temperature up to tropical limits should not adversely affect the permanence.

(iii) In the event of overheating or fire, the insulation should not promote combustion.

Cellulose acetate tubing, in a commercial thickness of 0.06 in., allowed to dry thoroughly after softening, rises to an electrical breakdown of some 9,000 volts; it has been developed for tropical use, and when deliberately ignited it burns dully; indeed, when used as a covering on copper bar, combustion is supported with difficulty. Some applications and processes of fairly general use are here considered.

BUSBAR COVERING.—Plain cylindrical bars or rectangular bars are covered by the tube in the normal way. The tube is selected so as to give 10 to 40 per cent. extension, softened by immersion in acetone solution, and expanded on over a pointed mandrel. Rectangular sections with rounded edges are preferable, so as more easily to avoid cutting the soft tube.

END CAPPING.—The ends are sometimes provided with a flat piece cemented in (Fig. 1). The tube is first allowed to shrink and the end piece is then inserted.

Fig. 1.—End cap for cylindrical bar.

Fig. 2.—Formed end cap.

For rectangular sections which are flat it is often easier to form over the end of the tube and cement the lips (Fig. 2). In this process the tubing is left half an inch too long and the end is clamped flat and so held while it dries. Cement is used so that the end becomes almost solid. It can then be trimmed by cutting and filing. The clamp does not grip too close to the bar end when first put on; this allows for the lengthwise shrinkage.

BOLTED JOINTS.—Joints in flat bar are made usually with ring contact (Fig. 3). The tube covering is trepanned locally and the central ring connecting the bars is slightly thicker than twice the tubing

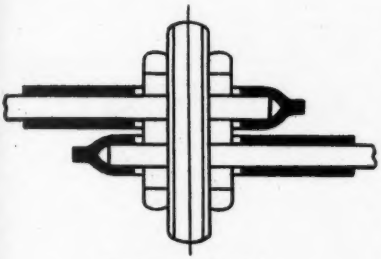


Fig. 3.—Bolted joint.

thickness. The stud ends are finally covered by using an internally threaded cap, moulded in cellulose acetate and having a skirt which covers the nuts.

TEE CONNECTIONS.—For flat bar, these are made in the same way as other bolted joints, and for connections to circular bar the metal clamp device, whatever its form, is shrouded by a split box. This box is suitably built up of insulation material, and is usually covered with cellulose acetate by the spray process.

FORMED SHAPES.—An example of simple forming is shown in bell-shaped tube required for shrouding. The bell is opened out to about twice its body diameter and closed in to leave a hole at the opposite end about half the body diameter (Fig. 4).

To produce this, standard tube is used. It is expanded on to a former, the free end shrunk by immersion in hot water, and folded in by hand. An outside former is then clamped on which forces the free end into shape. The hole is finally " trepanned " to size (Figs. 5, 6, 7).

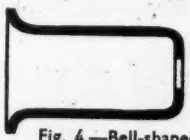


Fig. 4.—Bell-shaped tube for shrouding.

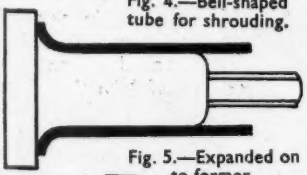


Fig. 5.—Expanded on to former.

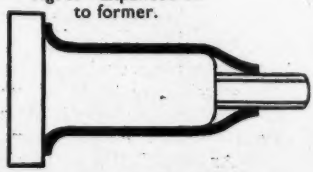


Fig. 6.—Free end shrunk in.

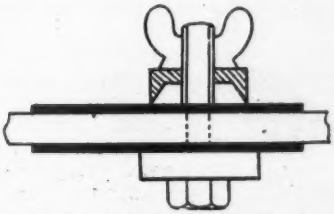


Fig. 8.—Method of " trepanning."

Fig. 9.—Lever grip.

TREPANNING.—The material is somewhat tough when dried, and drying is necessary before cutting, since shrinkage continues until all the solvent is dried out. The most suitable tool for " trepanning " is in the form of a circular knife edge, forced directly through the tubing (Fig. 8).

HANDLE GRIP.—One further device which is useful is the inclusion of a serrated grip in the covering of a lever. The lever is fitted with a helix of wire over the grip portion. The tubing is expanded over both and, on shrinking, forms very suitable undulations for the grip (Fig. 9).

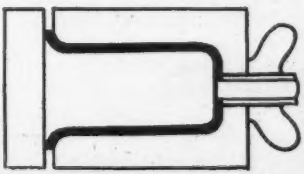


Fig. 7.—Forcing free end into shape.

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World's Industry Employs Plastics

GENERAL ENGINEERING

Laminated bearings for heavy duty and severe service are described by E. P. Littlefield. Advantages and limitations are presented in the light of experience. Properties and several of the more important applications are described in detail. ("Product Engineering," 1949/Jan./111.)

Electric impact hammer for fabricating metals and plastics has been developed by Black and Webster Inc., Needham, Mass., incorporating a high-temperature silicone insulated coil. The solenoid gives more than 150 blows per min., with an impact of more than a ton. ("Materials and Methods," 1949/Mar./106.)

Non-metallic coatings.—J. Delmonte describes the engineering characteristics of non-metallic protective coatings. ("Machine Design," 1949/Feb./97.)

Hardness of organic coatings.—G. Black gives a survey on the various principles applied in hardness testing of organic coatings. He distinguishes between scratching, pendulum methods, indentation resistance, impact resistance, tensile strength of detached films, resistance to abrasion and other methods.

Plastics in engineering.—A general survey of well-known types of plastics for the engineering industry is given by P. S. Nigam. ("Science and Engineering," 1949/Jan./11.)

Testing plastics. — Modern technical development is recognized by the trend to measure more and more accurately. This was a main part of a lecture by R. Vieweg, before the Verein Deutscher Ingenieure. Instead of schematic single point measurements, in general, modern technique requires connected curves. Measurement and testing are not performed at the end of the production process, but incorporated in it. ("Kunststoffe," 1949/Mar./64.)

Adhesive bonds.—Irving Silver has investigated shear impact and shear tensile properties of adhesives used in ordnance equipment. The data, in paper presented to Society of Plastics Engineers, were evaluated by statistical analysis. ("Product Engineering," 1949/Mar./150.)

Dimensional stability. — H. Liander discusses the causes of dimensional variation and cracking, as well as deformation, of moulded plastics, and indicates the important influence of humidity. ("Tekn. Tids-Kr.," 1948/Nov./763.)

A.S.T.M. Standards.—The 4th edition of the Standards sponsored by A.S.T.M. Committee D-20, dealing with about 85 testing methods, has been published. ("Product Engineering," 1949/Jan./190.)

ELECTRICAL

Neoprene - coated cable. — Electrical conduit in which neoprene is directly bonded to metal is useful for the wiring of machine tools, chemical plant, underground circuits, etc. ("Electrical Construction and Maintenance," 1949/Feb./108.)

Electric plugs equipped with one or two finger grips are made of ivory-coloured plastic. The producer is Thyco Electrical Products Inc., 849 S. Kenmore Avenue, Los Angeles, Calif. ("Business Week," 1949/Apr. 16/60.)

MISCELLANEOUS

Try-square handles, injection moulded in ethyl cellulose (Peck, Stowe and Wilcox, Southington, U.S.A.), are colourful and of long-wearing quality, lighter in weight and tougher than the conventional hardwood handles. ("Materials and Methods," 1949/Mar./69.)

Metallography.—In Sweden monomeric methyl methacrylate seems to be favoured for transparent mounts when mounting metallographic specimens. The polymer can be dissolved by benzene, chloroform or acetone, to release the sample. ("Jern. Kontor. Annaler," 1948/**132**/Sect. A/110.)

Three dimensional forming.—W. W. Farr describes a variety of methods for forming compound shapes of acrylic plastic sheet; they range from manual and mechanical means to vacuum and air-pressure methods. ("Materials and Methods," 1949/Mar./57.)

One-piece T-square of clear polystyrene (Instrumaster Industries, 2458 2W Jackson Blod, Chicago 12, Ill.) is said to maintain original accuracy after continued use and provides high visibility of surface on which it rests. Both sides of the square are equally usable. ("Product Engineering," 1949/Jan./172.)

Self-heating tape.—For assembly and repair operations, a ribbon of lead-tin solder is attached to a ribbon of vinyl plastic; during operation aluminium-type heating fuels are dispersed. ("Materials and Methods," 1949/Apr./57.)

Ethyl cellulose mouldings.—J. Zeelander offers a flowsheet on the manufacture of these relatively new thermoplastic materials. As a new designation, the expression "thermosoftening" is used. (Flowsheet No. 184, "Mechanical World," 1949/April 29/469.)

Fabricated plastics.—H. F. Pearson deals mainly with the fabrication of plastics for display. Growing tendency of production by firm making the entire product. Radio dials can more economically be made by radio company, advertising companies make their own signs, etc. (Abstract in "Product Engineering," 1949/Apr./150.)

Plastic binding by General Binding Corp., 816, W. Belmont Avenue, Chicago, can be made by the customer himself with the use of two special machines: a punch which punches rectangular holes the full length of the sheets to be bound, and a binder which holds open the rings of the plastic binding elements. ("Business Week," 1949/Apr. 16/60.)

Photoelasticity. — Westinghouse Research Laboratories have developed a new styrene-alkyd resin, "Fosterite," which is said to be superior to any other known material for frozen stress tests. ("Proc. Soc. Exper. Stress Analysis," 1948/Dec./19.)

Polyethylene films.—For use in packaging extruded polyethylene films of 0.0017-in. thickness were tested with 48 different fluids. The range of permeability was found to be extremely wide and repetition of tests is recommended. ("Product Engineering," 1949/Mar./152.)

Treatment of leather.—A complete research report by R. Oehler and T. J. Kilduff on treatment of leather with synthetic resin has been published. ("J. Res. Nat. Bur. Standards," 1949/Jan./63.)

Lignin.—Owing to the present difficulties in the phenol market, all countries producing plastics show increasing interest in lignin products. K. Kipphan investigated the plentiful available product acidized lignin from the sugar production from wood. In products where the dark brown colour of lignin and a reduction in quality of 50 to 70 per cent. is not of importance, lignin may not only become important as moulding powder, but also for lacquers, glues, acid-resisting cements, etc. ("Kunststoffe," 1949/Mar./71.)

B.I.F. 1949 in Retrospect

IF figures are any indication, 1949 saw the most successful of the British Industries Fairs since the end of the war. There were more than 16,100 overseas buyers, which number is 2,000 more than last year. We did not, we suppose, see all of them in the Plastics Section, but sometimes it seemed like it. Their questions were urgent and to the point, and they were full of unstinted praise for the design of the stands, the variety and range of new applications and, what is so important, of the general improvement in quality and design. Praise of the price level was not so evident—but perhaps one never expects that.

As always, there was a divergence of opinion as to whether business was good, bad or indifferent. No doubt the raw-material producers do not expect to sell tons of resin over the counter. They are sufficiently well-known and regard the Fair mainly from the propaganda point of view. On the other hand, they foster special interest by the display of new processes and new or little-known applications, in addition to any new resins that are produced. Thus, we were treated to a view of a new machine for the continuous heat-welding of polythene sheet for the new "packaging age" that is looming ahead, a new paste for slush moulding, an untearable paper, examples from the new casting process of making precision moulds, nylon mouldings, extensions in the pliable-mould technique, etc., in addition to the new "Nuron" (I.C.I.), "Geon" (British Geon, Ltd.), "Vybak" (Bakelite, Ltd.), "Marco" (Scott Bader, Ltd.) and "Claromene" (Dorman Long and Co., Ltd.). Newcomers to the raw material manufacturing section are Sterling Moulding Materials, Ltd., and British Paints, Ltd., both of which companies now produce resins of interest to the industry.

And what of the moulders and fabricators, who can give a more immediate answer, for it is they who face the impact of the buyer far sooner than any other section. A few, luckily very few, were not too happy, and one frank salesman thought he foresaw the end of plastic "crockery" production.

Business in these products was poor. but we disagree with the pessimism, born probably through believing by some aberration of the mind that plastics would capture a large section of the earthenware business. This would be fantastically impossible, but we firmly believe in plastic cups, saucers and plates for camping, picnicking and the caravan, and especially for the nursery. Exports will never be large, perhaps, since transport costs are heavy and such simple mouldings will always be made in most overseas countries.

Here the reverse side of the picture almost ends. On all sides the greatest relief and pleasure was felt that business was at least better than last year. Often it was much better. One could feel that the public reaction, remembering its revulsion to the shoddy expensive goods of 1945-6 and 1947, saw an improved quality in almost everything, and showed its appreciation. Gone from the market, for good we hope, is the flood of badly designed, useless gadgets of bent and twisted methacrylate or acetate. Gone, too, the cheaply made, badly fabricated, fragile strips of p.v.c. that angered almost every woman from Land's End to John o' Groat's. Gone, too, for good, unless we give them a chance, are the spivs of the industry. The whole industry will rejoice (for we are all affected) in the great change that has come to the p.v.c. and allied thermoplastic-sheet industry—we believe all makers and dealers and users of sheet are breathing anew. Better quality, more general manufacture of unsupported 20/1000-thick material, more general use of fabric-backed sheet for high-strength applications—and where frankly imitations of leather were made, such imitations were excellently done; we

shall write at some length on imitations and their value at some future date.

Business was really excellent in this section, which is growing rapidly; many who came to criticize left with admirable reports. In fact, one had only to visit the adjacent Leather Section to note that one or two ladies' handbag manufacturers had gone over completely to the use of p.v.c. with imitations of crocodile, morocco, snake skin and several interesting and purely plastic designs. We firmly believe that, although there is nothing like leather, p.v.c. has come to stay. One interesting, novel application of p.v.c. was the production of "enrober" belting for the conveying of chocolates and their stamping, and of biscuits.

Industrial mouldings, which so often require specific designing, are obviously not discussed in detail at the Fair, but the quality of units shown was so high that inquiries were numerous. Excellent business is hoped for, and this was reflected in the Toy Section where, again, several firms dealt only in plastic goods. There were satisfactory inquiries for lots of small units, from safety razors to a remarkable order for chopsticks for China.

And now a few words about the B.I.F. at Birmingham, which, for a variety of reasons, we prefer to Earls Court and Olympia, possibly because of the plastics machinery, possibly because of the greater proportion of industrial mouldings, and most probably because we could find our way about easier.

It was gratifying to see the growing stature of this backbone (presumably we have two!) of our industry, in the presses and allied machines of the stalwarts, Bradley and Turton, T. H. and J. Daniels, E.M.B. Co., Finney Presses, R. H. Windsor, Projectile and Engineering Co., and Francis Shaw. Compression and injection machines (some large ones were shown, too) held admiring crowds. These stands, and most of those of moulding concerns at Castle Bromwich, are seen in the photographs in the pages following.

Several concerns who are partly "in" the plastics industry are forced, because of the variety of their products, to show in the Chemical Section at Olympia. Among these are Monsanto Chemicals, Ltd., who supply us with so many phenols, arochlors, etc.; Scott Bader and Co., who manufacture "Marco" resins (contact resins) and "Rubbone"; and Boake Roberts, and Howards of Ilford, who specialize in plasticizers and solvents.

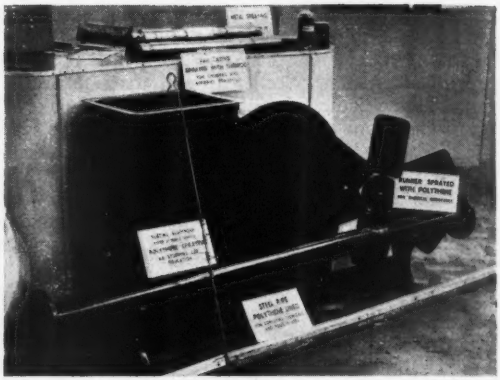
Great interest was shown at our own stand, where we had selected for exhibition what we considered some outstanding productions of the past year. Among these were the moulding of a grid ring, a very tour-de-force of brilliant mould production and moulding by British Moulded Plastics; Ashdown's moulding for a stud-welding gun; Tenaplas's 12-in. extruded tube of polythene, which some (12 months ago) thought an impossible job; a medical appliance housing by Thermo-Plastics; polythene bottles; Clutson and Kemp's woven p.v.c. strip; Crystalate's production of a watch-display case for Longines, and Shipton's new moulding for their "Intercall" telephone system. We think that visitors learned a lot about how the plastics industry can serve the world.

Earlier in these notes we stated that we preferred the Birmingham B.I.F. to the Earls Court Show, and we assure our readers that we have no more than ordinary yearnings towards "Brum." But the Castle Bromwich building is at least built for an exhibition. It is a long, big building, with the avenues built as they should be, on simple, straight lines with cross-cutting alleyways at right angles and regular intervals to the avenues. They are clearly marked for everybody to see with large, clear lettering for the avenues and clear lettering and numbers for the stands. The veriest simpleton could not lose his way.

Layout at Earls Court is much less simple. The avenues, especially those on the sides, conform to the irregular shape of the building and twist like any English road. Avenue indications are non-existent, stands are poorly numbered; even stand-holders themselves find it difficult to guide inquirers.

British Industries Fair

On this page and following we give further photographs taken at Earls Court and Olympia, and at the Engineering and Hardware Section of the Fair at Castle Bromwich.



(Above) Flame-sprayed plastic coatings, by Schori Metallising Process Ltd., for the protection of chemical and allied industrial plant. The fan casing is sprayed with thiokol; fan blades with polythene. A polythene-lined steel pipe is also seen.

(Left) Beetle Bond Ltd. show applications for "Beetle" urea-formaldehyde adhesives in joinery and constructional work.

General view of the exhibit by BX Plastics Ltd., displaying a complete range of the company's materials, which are supplied in sheet, rod, tube, powder and paste, and as monofilaments.

(Above) The "Intercall" telephone system shown by E. Shipton and Co. Ltd., has a one-piece receiver and transmitter in a polythene case, which can be supplied in a variety of colours.

(Below) This moulded saxophone, shown by British Moulded Plastics Ltd., was mentioned in our May issue. We illustrate it again, on a larger scale.

(Left) A variety of grains in plastic leathercloth for handbags, belts, travel goods, shoes, and as upholstery material, are displayed by Armoride Ltd.

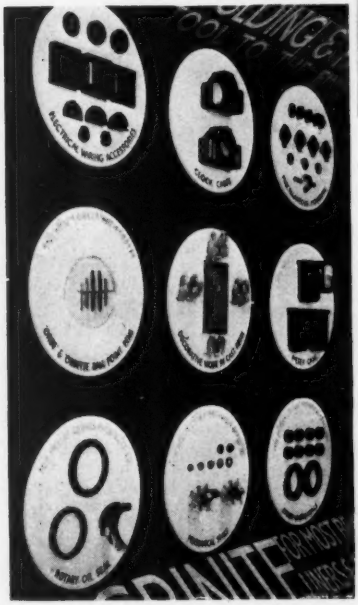
(Below) Laminate productions shown by Hill, Norman and Beard Plastics Ltd. included "Formica" tops for kitchen cabinets.

(Above) Laminated materials for the surface of walls, and for furniture, were seen at the stand of Warerite Ltd., in the furnishing section of the Fair. This corner-fitting cocktail bar is made throughout of "Warerite" materials. The bar top is cigarette-proof, and incorporates the new Warerite Weave pattern. The front of the bar illustrates the responsiveness of "Warerite" panelling to the requirements of the designer.

(Right) Jas. Williamson and Son Ltd. demonstrate the useful qualities of their p.v.c. leathercloth for upholstery and wall covering.

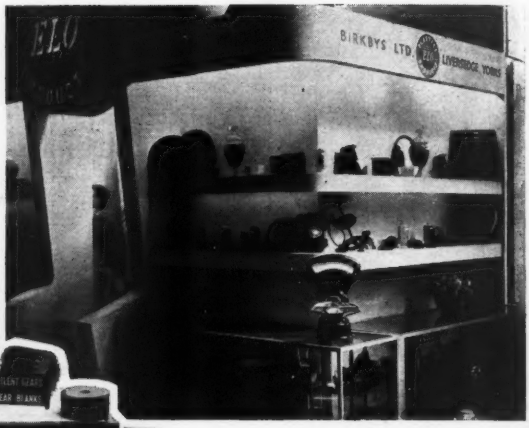
(Above) A corner of the exhibit by Moulded Products Ltd., showing a new plastic helmet for firemen.

(Below) Shires and Co. (London) Ltd. shownon-corroding frost-resisting plastic lavatory cisterns and moulded lavatory seats.



(Left) Lacrinoid Products Ltd. show a variety of mouldings, including wiring accessories, clock cases, pens, oil seals and meter cases.

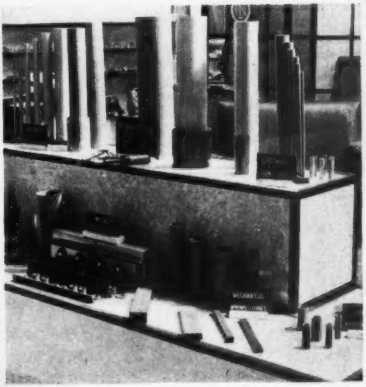
(Right) Part of the exhibit of builder's hardware moulded by Evered and Co., Ltd.

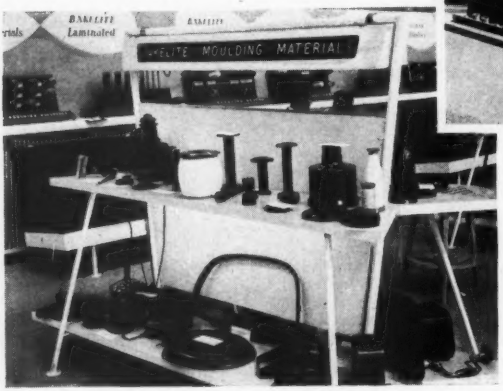


(Right) Mouldings for electrical, mechanical and other uses, produced in "Elo" materials, are exhibited by Birkbys Ltd., who also showed synthetic resins for bonding, and impregnating purposes.

(Above) Silent gears and heavy-duty bearings in resin-bonded fabric base laminates form another feature of the exhibit by loco Ltd.

(Below) Tubes of resin-bonded paper base laminates for electrical insulation purposes are displayed by loco Ltd.



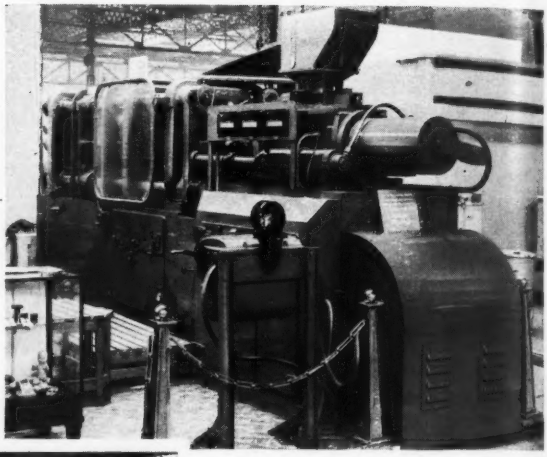


(Left) Exhibits by Bakelite Ltd. show the way in which this company's moulding materials are helping to increase productivity in the textile, electrical, general engineering and other industries.

(Right) This small high-frequency preheater with an output of approx. 450 watts at about 50 Mc/s, sufficient to plasticize 5-6 oz. of moulding powder per minute, was shown by E.M.I. Factories Ltd.

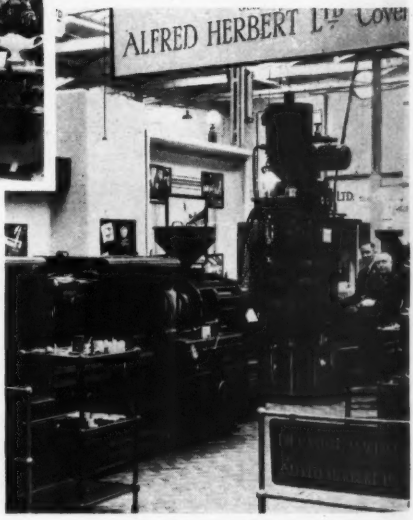
(Left) This injection moulder was one of the features at the stand of E. M. B. Co., Ltd. Powered by compressed air, the locking force of the dies is 136 tons, applied direct through an intensifier system.

(Right) Finney Presses Ltd. exhibit their 50-ton dual transfer and compression press; also, further to the right, a 200-ton hobbing press.



(Right) R. H. Windsor, Ltd., exhibit a 16-oz. injection moulding machine; also moulds for thermoplastic materials. As on several other stands, working demonstrations were given.

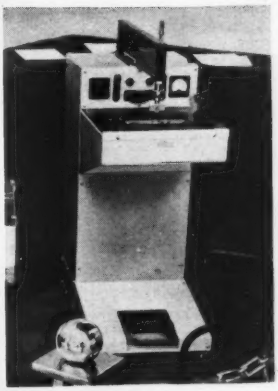
(Left) Foster, Yates and Thom, featured equipment for the making of synthetic boards, and this 250-ton transfer moulding press.

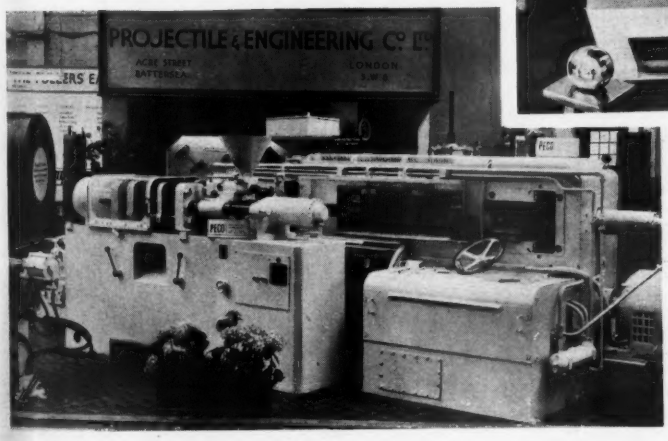


(Right) A range of plastics moulding machinery provided the joint exhibit of Alfred Herbert, Ltd. and T. H. and J. Daniels, Ltd., where a 125-ton transfer press was in operation. Other exhibits included the Daniels hobbing presses and preforming machines.

(Above) Plastics machinery shown by Bradley and Turton, Ltd., included their 100-ton semi-automatic hydraulic moulding press with self-contained pump unit.

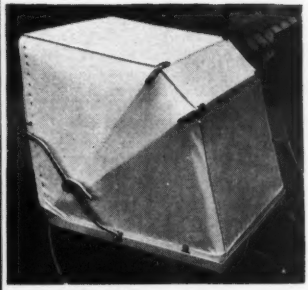
(Below) The extensive range of high frequency equipment for the plastics industry shown by Radio Heaters, Ltd. included this H.F. welding machine.



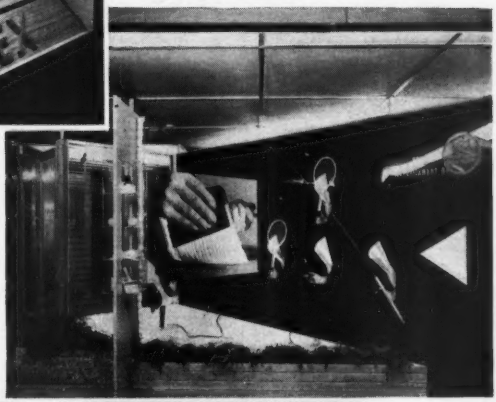


Plastic moulding machinery shown by the Projectile and Engineering Co., Ltd., included two of their range of "Peco" injection moulding machines, which were described in "Plastics," Sept. 1947, page 489. The 2-oz. machine is seen in the foreground (to the left) and the 8-oz. machine at the rear of the stand. Both machines incorporate recent improvements.

(Above) Plastic insulating sleevings and p.v.c. covered wire are shown by Suflex Ltd.



Plastic leather cloth for pram canopies (Leather Cloth Co. Ltd.)



(Right) This impressive exhibit by I.C.I. (Plastics Division) illustrates the many uses for nylon mono-filaments.

(Left) This journal presents various aspects of Britain's plastics industry to the world.

Welding of Rigid Polyvinyl Chloride ("Vinidur")

By Paul Voigt*

Translated from "Autogene Metallbearbeitung," Vol. 35 (1942), No. 12 by G. HAIM

THE chemical resistance of unplasticized polyvinyl chloride sold under the trade name of "Vinidur" has been investigated for many applications, and the results have been published elsewhere.[1, 2, 3] The principle underlying the synthesis of this material has also been referred to in the literature.[4, 5]

The mechanical properties of "Vinidur," especially fatigue properties, have also been published.[6] A considerable advance in the application of thermoplastic materials has been brought about by the introduction of hot gas welding,[7, 8] and the valuable properties of "Vinidur" can only be utilized to their full extent by welding.

Welding Equipment

"Vinidur" begins to flow at a temperature of approximately 200 degrees C. It softens without melting and does not show a colour change. Above this temperature, decomposition takes place inside a very narrow temperature range. At the same time, the chemical resistance and the physical properties are impaired. The welding temperature is considerably lower than that used for the welding of metals, and this has led to the development of a new welding process and new welding tools. The very narrow temperature interval prohibits the use of an open welding flame.

Fig. 1 illustrates a T.P.-type welding torch. The welding gas (compressed air) and the heating gas are supplied through rubber tubing (A, B). Heating of the coil is effected by a flame emerging from a nozzle (C). The bore of this nozzle bears no relation to the thickness of the sheets to be welded, since only the surface of the welding seam has to be heated. It is, however, necessary to use nozzles of different bore for different welding gases; for instance, a nozzle with three outlets of 0.3 mm. bore for hydrogen; a nozzle with one outlet of 3 mm. bore for acetylene; and a nozzle with one outlet of 5 mm. bore for town gas.

The heating coil (D) consists of a tube of 3 mm. bore and is approximately 500 mm. long. This coil should be made from heat-resisting steel to increase its service life. The coil is protected by an interchangeable cover (E). The nozzle for the welding gas (F) is also interchangeable and can be attached to the heating coil. Nozzles of 3 mm. bore should be used for the welding of sheets of different thickness; three different nozzles are supplied with each welding torch. The extension piece of the nozzle can be bent to permit welding in inaccessible places.

Heating gases which may be employed include hydrogen, acetylene-air mixture, coal gas and air mixtures, propane and butane. The welding gas is supplied from a compressed-air cylinder or from a compressor via a reducing valve. Hydrogen is drawn directly from the cylinder; for acetylene or coal gas an injector or mixing valve is required to ensure complete combustion and sufficiently high temperature of the flame. Fig. 2 illustrates the way in which the injector should be connected to the welding torch. For safety reasons the use of oxygen is not recommended, owing to the danger of setting fire to the plastic material, especially in tanks or containers. Where nitrogen, coal

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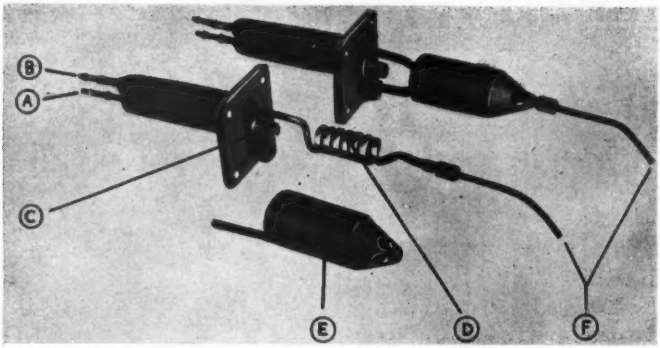


Fig. 1 (above).—Gas heated welding torch (Type TP).

(A) Connector for hydrogen supply.
(B) Connector for compressed-air supply.
(C) Jet for hydrogen flame.
(D) Heater coil.
(E) Protective cover over heater coil.
(F) Jet for welding gas.

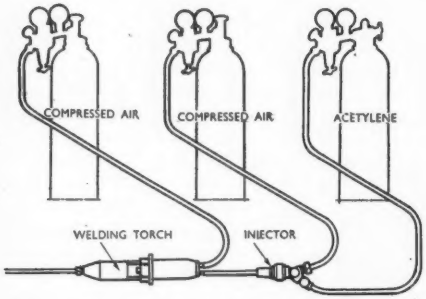


Fig. 2 (left).—Connection diagram for welding torch using acetylene or town gas, an injector being used.

gas or carbon dioxide are used, the danger of poisoning should be considered.

For welding in buildings where explosion hazards exist, the use of electrically heated torches is recommended. Fig. 3 shows an electrically heated torch, operated from a 42-volt supply, for use in such situations.

The welder has to adjust the heater flame and the welding gas pressure. Reducing valves which can be adjusted within fine limits should be used; stopcocks are unsuitable. The success of welding depends on proper adjustment of the welding torch, and care should be taken to provide suitable valves.

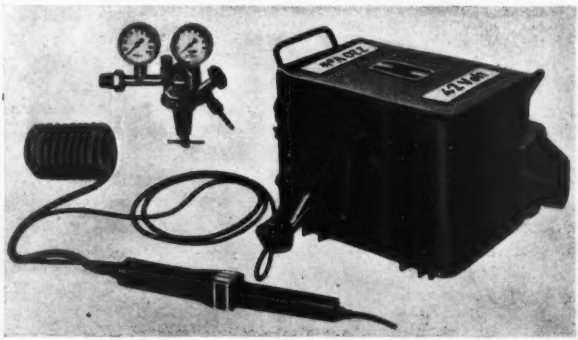


Fig. 3.—Electrically heated torch and transformer for working in rooms where an explosion hazard exists.

Preparation of the Welding Seam

Fig. 4 shows the various types of welds which can be executed; these are butt welds, corner welds, fillet welds, and lap welds. Wherever possible, butt ends should be used. The very low endurance limit of "Vinidur" (190 kg./sq. cm.[6]) makes it imperative to avoid unnecessary stresses. In the case of a lap weld made with sheets 2 mm. thick a considerable increase in stress is caused by the bending moment.

The following calculation shows a comparison between the permissible loading for a butt weld and a lap weld in 2 mm. "Vinidur" sheets under tensile stress.

σ endurance limit of "Vinidur" = 190 kg./sq. cm.

α, quality factor of the weld: butt weld = 0.75, lap weld = 0.65.

a_1, full height of the butt weld = 2 mm.

a_2, full height of the lap weld = $0.7 \times S = 0.7 \times 2 = 0.14$ mm.

l, length of the seam = 100 mm.

F_s, area of the weld = $a_1 \times 1$ or $a_2 \times 1$ in sq. cm.

e, centre distance of sheets to be welded.

W, moment of inertia = $\frac{e \times l^2}{6}$.

Under this assumption the maximum permissible load of the butt weld

$$P = F_s \times \sigma \times \alpha$$
$$= (0.2 \times 10) \times 190 \times 0.75$$
$$= 285 \text{ kg.}$$

In the case of a lap weld

$$P = \frac{\sigma \times \alpha}{\left(\frac{1}{F_s}\right)^2 + \frac{e}{W}}$$

$$= \frac{190 \times 0.65}{\left(\frac{1}{0.14 \times 10}\right)^2 + \frac{0.2}{0.033}}$$

$$= 20.25 \text{ kg.}$$

From this calculation it can be seen that the ratio of maximum loads in both cases is

$$285 : 20.25 = 14 : 1.$$

Consequently, whenever possible, butt welds should be made.

Preparation of Welding Edges

Due to the fact that proper fusion cannot be achieved, it is recommended to bevel sheets even of 1 mm. thickness. An angle of 60 degrees is used for sheets up to 5 mm. thickness, and 70 degrees for sheets of greater thickness. Corner welds should be prepared in a similar way. For sheets thicker than 6 mm., bevelling from both sides should be carried out, as shown in Fig. 10. The amount of welding rod required for V- and X-seams shows that V-seams require approximately twice the amount of welding rod used for X-welds.

Special care should be taken to avoid stresses due to notches within the weld. All thermoplastic materials have the property of being sensitive to notches and this, in conjunction with the stresses caused by shrinkage, reduces the physical properties considerably. Failures occur in most cases at the root face where proper welding has not been achieved. A weld which is faulty at the root reduces the mechanical strength by about 50 per cent. A gap of 0.5 to 1 mm. should be left to ensure proper penetration at the root and the filler rod should be pressed into this gap. At least half of the cross-section of the filler rod should emerge from underneath (Fig. 6).

Butt Welds with Root Reinforcement

Where a gap exists between the adjoining edges, butt welding requires a considerable amount of skill on the part of the welder; in such cases it is preferable to reinforce the weld from the back by a sealing run (Fig. 7).

The sheets are carefully pressed together so that no gap is left, and are clamped down in this position (Fig. 7A). Subsequently, the first layer is deposited with a filler rod of 2 mm. diameter (Fig. 7B). Before depositing the reinforcing run a groove is scooped out at the back of the weld by means of a scraper (Fig. 7C). This groove is then filled in with a 3 mm. filler rod (Fig. 7D).

Where comparatively thick sheets are involved, bevelling from both sides is recommended, in which case there is no need for providing such a groove.

CORNER WELDS.—Due to the fact that the "Vinidur" softens only locally, the three types of welds shown in Fig. 4B can be used. For the preparation and welding of the first layer all the precautions recommended for plain butt welds apply. Where considerable stresses may occur, a reinforcement weld at the back of the joint should be made. It may be an advantage to carry out the welding operation in such a way that the welded seam is not visible from the front. Final polishing of the material after welding is not impaired by the application of heat during the welding process.

FILLET WELDS.—In the case of fillet welds (Fig. 4C), care should be taken that the vertical leg makes proper contact with the horizontal leg, i.e., without a gap. The first layer is deposited using a 3-mm. filler rod. Welding from one side only causes additional stresses, and it is, therefore, strongly recommended to make fillet welds from both sides. In the construction of tanks, pans, etc., where fillet welds are used for partitions, vertical joints can be reduced in cross section, as shown in Fig. 4C; in this case it is permissible to dress the welds afterwards without impairing the strength of the joint.

LAP WELDS.—Fillet welds should be employed only for the sealing of pipe joints, similar to Fig. 4D, when mechanical stresses are low. It should be remembered that considerable stresses may be caused by thermal shrinkage. Lap welds are especially recommended for the sealing of screwed sleeves; all the stresses which may occur are concentric, thus reducing the danger of cracks. The cross-section of the pipe to be welded is very small and joints of this type are comparatively simple.

Filler Rods

Filler rods of "Vinidur" containing 10 per cent. plasticizer should be used. The plasticizer is in most cases merely added to improve the extrudability of the material. Experiments have been carried out with rods of round, triangular, square and hexagonal cross-section; it was found that round filler rods give by far the best results. This is due to the more uniform heating-up of round sections compared with any other type of rod. Tests were carried out using rods of various cross-section to find out the actual strength of butt welds with an angle of 70 degrees. The average results of these tests are given in Table 1.

Table 1.—Tensile Strength of "Vinidur" Welds made with Rods of different Cross-section.

Form of filler rod	Diameter mm.	Weld Strength
Triangular ..	3	50% of strength of parent material
Square	3	60% of strength of parent material
Hexagonal ..	3	70% of strength of parent material
Round	3	85% of strength of parent material

In all cases three weld layers were deposited.

In practice, filler rods of 2, 3 and 4 mm. diameter are used. The root layer should always be deposited with a smaller rod than the subsequent layers For the sealing of pipes only 3 mm. rods should be employed. Rods with a diameter larger than 4 mm. cannot be softened sufficiently with the ordinary T.P. welding torch and should not be used. Filler rods containing a higher plasticizer content than 10 per cent. soften too quickly and yield unreliable results. The beginner is easily deceived by the better flow properties of the filler wire and very often omits to heat the base material sufficiently. Filler wires of smaller diameter, for instance 2 mm., containing a comparatively high plasticizer content, present certain difficulties when depositing the root layer, especially when the sheet material is rather dark; even an experienced welder may encounter difficulties in such cases.

The tensile strength of the filler rod bears no relation to its suitability for welding, nor does it indicate the actual strength of the welded seam.

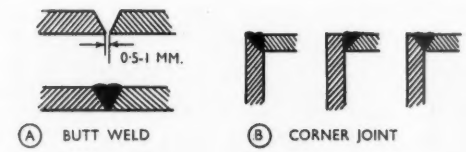
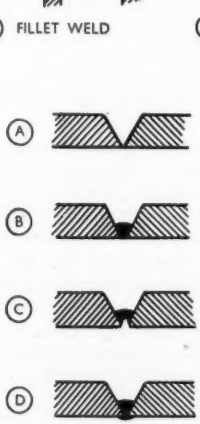


Fig. 4 (left).—Different types of joints employed for the welding of plastics.



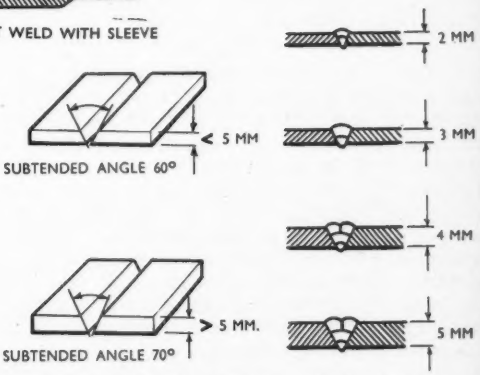


Fig. 5 (above).—Preparation of "Vinidur" welds.

Fig. 7.—Procedure for butt welds with sealing run.

(A) Fit prepared edges without gap.
(B) Weld in root layer.
(C) Mill suitable groove at root.
(D) Deposit sealing run.

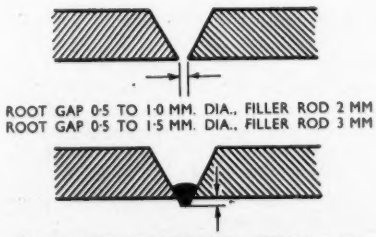


Fig. 6.—Details of butt weld with root gap.

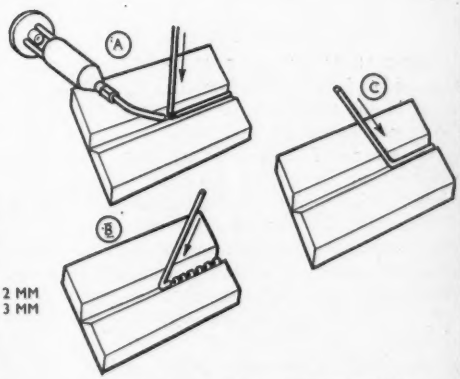


Fig. 8.—Right and wrong welding procedure.

(A) Correct angle of filler rod, almost vertical.
(B) Angle incorrect.
(C) Direction of filler rod unsuitable.

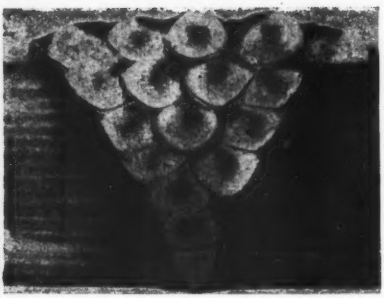


Fig. 9.—Cross-section of "Vinidur" butt weld (V) 10 mm. thick.

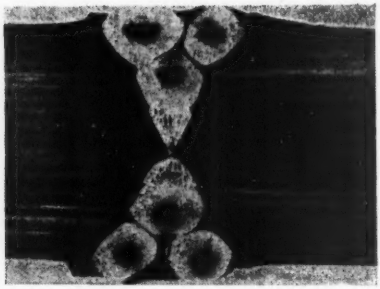


Fig. 10.—Cross-section of "Vinidur" butt weld (X) 10 mm. thick.

CORRECT WELDING TEMPERATURE.—Metal welders are accustomed to judge the correct temperature either from a colour change of the material, or from the fluidity of the molten metal. Unfortunately, "Vinidur" does not behave in this way. When heated, it only softens without becoming liquid, and a comparatively low pressure is sufficient to effect bonding. The base material, which originally has a very smooth surface, becomes rough in the course of heating; when heating is continued the material darkens, becomes brown and finally black, which indicates burning or decomposition. The welded seam should show some gloss after dressing.

The Welding Process

ADJUSTMENT OF WELDING TORCH.—It has been found advisable to keep the flame of the welding torch always under the same conditions, and to control the temperature of the welding gas by reducing or increasing the flow. The correct temperature of the welding gas (250 degrees C.) can be measured by a thermometer held approximately 5 mm. away from the tip of the welding torch. The welder may, however, ascertain the correct temperature by directing the jet of welding gas against the back of his hand. At the same time, he will obtain the required pressure by adjusting the reducing valve of the compressed air.

HOLDING THE FILLER ROD.—The filler rod should be held almost vertical, as shown in Fig. 8A. Where the filler rod is held at an angle, stretching of the rod may occur which results in insufficient bonding and subsequent stresses. Cracks in the deposit caused by stresses exceeding the strength of the material at elevated temperatures are shown in Fig. 8B. In general, such cracking occurs either at once or at least when depositing the second layer due to the reheating of the first layer. If the filler rod is held in the opposite direction as shown in Fig. 8C, satisfactory heating cannot be achieved at the root. In this particular case too much heating of the filler rod takes place and under slight pressure the filler rod collapses.

Proper bonding of the filler rod to the parent material can easily be recognized by a small ripple that moves in front of the filler rod as welding proceeds. Further signs of proper bonding are the two humps which form on both sides of the filler rod. These humps are clearly visible in Figs. 9 and 10. When these reinforcements are absent severe notch effects occur. The use of proper bonding pressure on the filler rod can be recognized in a polished cross-section of the weld, because the filler rod which was originally round assumes the form of the cross section. This is illustrated particularly well in Fig. 10. Special care should be taken to bond the weld deposit to the parent material in such a way that notch effects cannot occur.

CORRECT WELDING PROCEDURE.—The correct position for the welding torch and the method of welding are shown in

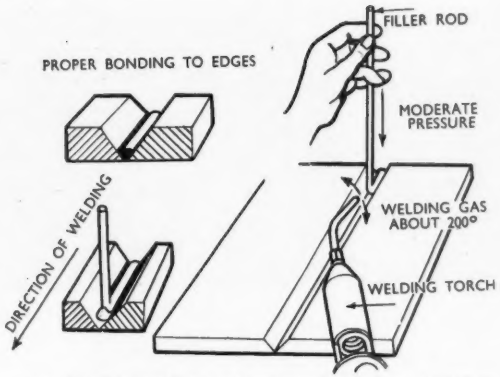


Fig. 11.—Manipulation of torch and direction of welding.

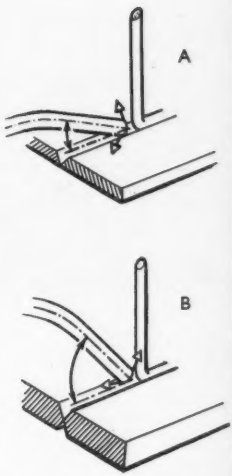


Fig. 12.—Correct angle of torch orifice for sheets of various thicknesses.
(A) Thin sheets, shallow angle.
(B) Thick sheets, steep angle.

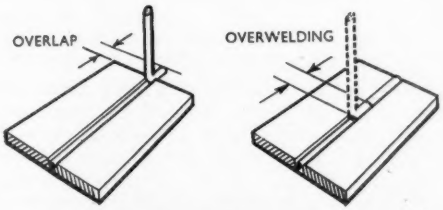


Fig. 13.—Correct procedure for beginning and restarting a weld. Left: starting correct. Right: continuing a weld, using new filler rod.

Fig. 11. It is essential to heat base material and filler rod uniformly. This can only be achieved by holding the torch at the correct angle and by a slight weaving motion of the torch orifice. This orifice should be held parallel to the welding seam in order to avoid non-uniform heating of the edges of the material. A slightly steeper angle is used for thicker materials (Fig. 12).

When starting a new seam (either V- or X-seams) one end of the filler rod should be bent over so that approximately 1 cm. of the rod remains in the gap (Fig. 13). This is done to achieve proper bonding right from the start. Whenever a new rod is used the same procedure should be employed. Every end of a filler rod welded into a seam should then be cleaned with a heated knife so that proper bonding of the next layer can be achieved.

The welding speed depends on the temperature of the welding gas; expert welders may increase the temperature up to 280 degrees C. Too high a temperature causes burning (decomposition) of the base material. If the filler rod is overheated, bubbles can be observed in the material and the strength of the weld is considerably reduced. Beginners are advised to keep the temperature down to approximately 210-230 degrees C.

Influence of Temperature and Welding Procedure on Strength of Welded Seam

It has already been mentioned that the mechanical properties of the weld depend entirely on the correct adjustment of the welding gas. This is seen, in Table 2, where the results of too high or too low a temperature are tabulated.

The filler rod should be held perpendicular to the welding seam, and sligh

Table 2.—Influence of Correct Heating of Parent Material and Filler Rod on Strength of "Vinidur" Welds.

Heating conditions	State of bond	Position of fracture	Appearance when fractured	Tensile strength
(a) Both filler rod and parent material insufficiently heated.	Little or no bonding on edges	Along the edges of parent material.	Along surface of filler rod or edges.	30%
(b) Filler rod properly heated; parent material insufficiently heated.	Proper bonding between individual layers of filler rod; insufficient bonding on edges.	Along the edges of parent material.	Bevelling still visible.	30-50%
(c) Filler rod overheated; parent material properly heated.	Burned section in weld deposit sometimes; also burned parts on edges.	In weld deposit.	Fracture occurs in deposit (burned sections).	50%
(d) Filler rod properly heated; parent material overheated.	Burned sections in weld deposit and chamferred edges.	Either in weld deposit or along edges.	Fracture occurs between deposit and parent material.	50%
(e) Both filler rod and parent material properly heated.	Proper bonding is achieved between individual weld layers and parent material.	Either in weld or in transition zone.	Fracture in deposit or parent material.	100%

pressure should be exerted towards the base material. The heating zone should be rather confined, i.e., the welding gas should be directed against the filler rod, but rather close to the seam. Special care should be taken to exert correct pressure on the filler rod, otherwise the usual strength of approximately 70 per cent. of that of the base material cannot be achieved. Stretching of the filler rod due to bending is unavoidable, and this results in most cases in a reduction of strength of about 20 per cent. Any further stretching will reduce the strength still further. This is due to stresses in the filler rod, set up by excessive longitudinal shrinkage.

The following résumé sets forth the reasons for increased stretching of the filler rod:—(1) The filler rod is inserted under too high a pressure. (2) The filler rod cannot follow the welding operation properly and lags behind the weld (due to incorrect welding angle). (3) The filler rod has been heated up over too large an area.

Fracture of a tensile specimen shows clearly whether too much or too little stretching has occurred during the welding operation. Welded seams with high longitudinal stresses show a very short and clean fracture, in most cases right through the welded seam. These fractures closely resemble those obtained with metals which have not undergone any deformation. The fracture of a weld with very low longitudinal stress shows a number of radial fissures emanating from the centre of the fracture, which often extend into the base material.

A series of tensile tests showed that 60 per cent of all welds reach over 70 per cent. of the strength of the base material. In view of this fact, it is possible to use for the calculation, methods such as are used for the calculation of welded steel.

Shrinkage Stresses in "Vinidur" Welds

Apart from shrinkage stresses in the longitudinal direction of the seam, which are caused by stretching of the filler wire, additional stresses at right angles to the seam can be observed.

The origin of this transverse stress is due to the fact that, owing to the low thermal conductivity, the base material is only heated in a confined zone. The high coefficient of expansion of the filler rod causes a considerable increase in the volume of the filler rod, which has been thoroughly heated. During the cooling

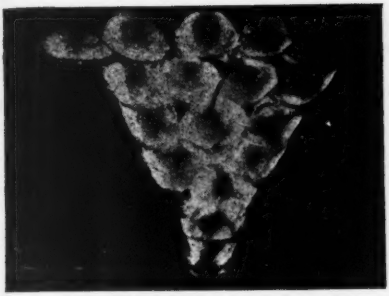


Fig. 14.—Cross-section through V-seam. Transverse stresses become visible under polarized light.

Fig. 15.—Cross-section through X-seam viewed under polarized light. Stresses are seen in the root of the weld.

period the cross-section of the rod contracts, and thus induces shrinkage stresses in the weld.

When examining the welding seam in polarized light, these transverse stresses can be observed by means of the colour change, which is particularly prominent at the points of increased stresses. Fig. 14 shows a V-seam and Fig. 15 an X-seam under polarized light; the fields of stress concentration can be observed very well in the cross-sections of the individual layers.

Longitudinal stresses have been measured with a special type of instrument which permits the measurement of changes in length of the order of 1/150th mm. After marking a gauge length on the welding seam and measuring it accurately, the seam was cut out from the sheets and the gauge length remeasured. After determining the elongation δ it is possible to work out the stress for an elastic material to the

formula $$\sigma = \frac{\delta E}{l}$$

where σ = stress.
δ = elongation.
E = modulus of elasticity.
l = gauge length.

The elongation which has occurred during welding can be determined by reheating the cut-out section. Values of stresses calculated in this manner cannot be considered to be very accurate, owing to the variations in the material and to the consequent variation in the modulus of elasticity; no attempt was made, therefore, to evaluate these data.

The assumption that neither warping nor shrinkage occur in the welding of "Vinidur" has not been confirmed. Distortion and warping occur just in the same way as in the welding of metallic materials. It is possible, however, to prevent this by suitable welding procedure and special precautions, such as keeping the zone adjacent to the weld at the lowest possible temperature. Experience gained in the welding of metals can be usefully employed in many cases.

Special care has to be taken when welding hot formed parts, because the reheating during the welding process may release stresses and cause the parts to return to their original shape. This can be prevented by using suitable clamping devices and formers on which the parts to be welded are held in position. It is also advisable to use thin filler rods as these require less heat for welding.

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Cellulose Acetate Plastics

XXII.—Chemical Tests

By
Vivian Stannett

NO account of the technology of cellulose acetate plastics can be considered complete without a description of some of the more important control tests which have to be applied during their production. These involve tests on the completed plastic as well as the individual ingredients. The latter consist essentially of cellulose acetate itself, plasticizers, and the volatile solvent, usually acetone. It is proposed to first discuss the tests usually applied to these materials and finally to discuss tests carried out on the finished product. The methods described have been proved in practice to give reliable results, although references will be given to more extensive discussions into methods of test.

Grades of Cellulose Acetate

The importance of the acetyl value and viscosity of this ingredient on the properties of the plastic has already been described. Manufacturers supply cellulose acetate in grades conforming to a rather wide range of values with respect to these two variables. As an example, Table I lists a summary of the commercially available grades as put out by one particular manufacturer. Each batch of acetate received by the plastics manufacturer is tested for acetyl content and viscosity to keep a check on its uniformity, and in the case of viscosity to make adjustments in the process where this is important such as in the case of film casting.

Table I.—Commercial Grades of Cellulose Acetate.*

Variety	Type	'Acetyl' Value (% combined acetic acid)	Viscosity Range (seconds)
Plastic	PL.1	52.5—53.5	12—20
	PM.2	52.5—53.5	20—30
	PM.3	52.5—53.5	30—60
	PH.1	52.0—53.5	85—120
	PV.1	52.0—54.0	above 500
Film	FM.3	56.1—56.6	20—25
	FM.6	55.5—56.2	35—55
Water resisting	WH.1	56.5—57.5	150—250†
	WH.2	58.4—59.0	150—200†
Lacquer	LL.1	55.0—56.0	2—4
	LM.1	54.0—55.0	25—50
	LH.1	54.0—55.0	60—80

* Hercules Powder Co. Ltd.
Viscosity determined at 25 deg. C. Hercules falling ball method 20% solution, by wt., in 90:10 acetone: ethanol mixture (by wt.)
† WH. grades in 90:10 methylene chloride:ethanol mixture.
"Medium" viscosity grades usually lie between 20 and 60 seconds—with "high" and "low" viscosity grades above and below respectively.

In addition to these two tests, moisture content, free acidity, colour, haze, and stability tests are also carried out. Stability and acidity tests are very important in relation to the wearing qualities of the plastic and also the effect of high temperatures such as are involved during injection moulding on the colour and impact strength of the plastic. A number of specifications are available, laying down suitable limits for these properties.

Viscosity[1, 2, 3]

Two different methods are used for the routine industrial determination of viscosity of cellulose acetate solutions, although, of course, many other methods are available. These are (1) the viscosity of dilute solutions using an Ostwald type viscometer and (2) the viscosity of concentrated solutions using a falling ball[4] viscometer. The latter type of viscometer is by far the most widely used at the moment for cellulose acetate work, although there is no particular reason why the first method should not be employed. The falling ball method may be more popular as highly viscous solutions are produced during the manufacturing processes for cellulose acetate and for film casting.

It should be emphasized here that for all normal industrial checking of viscosity only relative values, one to another, are obtained and these are rarely converted into absolute viscosity units. This can be done by calculation or preferably by using a solution whose absolute viscosity is known, such as sucrose or glycerol solution,[5] and thus calibrating the viscometer to be used.

Owing to the considerable effect on the viscosity of small amounts of water, it is usual to either dry out the cellulose acetate before weighing or to separately estimate the water content of the cellulose acetate and make it up to, say, 5 per cent. in the solution. As the water content is usually estimated in any case, the latter method is preferred. Acetone solutions are nearly always used or acetone and alcohol mixtures are sometimes preferred. For example, the Hercules method uses a 90 : 10 acetone-ethanol mixture for the falling ball method. Owing to the volatility of acetone, the solution must be made up in stoppered bottles. Usually, the solvent is added to the cellulose acetate which has been weighed out into the dry bottle and the correct amount of distilled water previously added. The bottle is stoppered and shaken very vigorously to separate out the cellulose acetate before lumping occurs. The stoppered bottle is then shaken on an automatic shaking machine overnight, when a complete and homogeneous solution usually results.

For the falling ball method, a 20 per cent. solution is a convenient concentration, whilst for the Ostwald method, the concentration can vary from about 0.5 to 5.0 per cent., according to the bore of the capillary tube of the instrument.

The Ostwald instrument (Fig. 1), which must be carefully cleaned and dried, is set up exactly vertically in a good thermostat regulated to around ±0.1 degree C. or better, if possible, owing to the large temperature dependence of cellulose acetate solutions. The correct levelling is also important and it is best to use a commercial levelling device to ensure the correct location each time the instrument

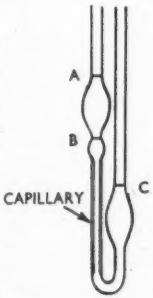

Fig. 1.—Ostwald-type viscometer.

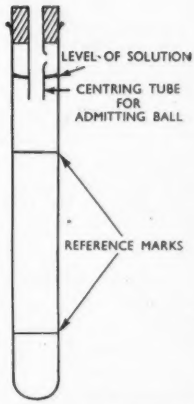

Fig. 2.—Falling-ball viscometer.

is removed and replaced in the bath. The cellulose acetate solution is filled into the viscometer up to the mark C, or, if no mark, an exact amount is added by pipette, the same quantity being always used. The solution is sucked or blown up to about 1 cm. above the mark A on the viscometer and the meniscus timed as it drops from mark A to mark B. At least three readings should be taken, and the mean value used as the correct one.

The apparatus for the falling-ball viscometer is shown in Fig. 2. The size of the tubes can vary, but a very convenient standard size normally used for cellulose acetate is a 1-in. tube with the marks 10 ins. apart. With these dimensions a $\frac{5}{16}$-in. diameter steel ball is used, the centring device tube being slightly larger in internal diameter. The tube is filled with the cellulose acetate solution and clamped exactly vertically in a good thermostat until all air bubbles have removed themselves, when the ball is dropped through the centring tube and its progress between the two marks timed by stop watch. Again three measurements are made and the mean taken on the final figure. It should be noticed that the centring tube not only guides the ball into the centre of the tube, but also allows the ball to enter the solution without carrying air bubbles with it.

Acetyl Value[14]

A number of methods have been developed for determining acetyl value, all giving a very reasonable degree of accuracy; most manufacturers have their own particular variation. In the case of the plastics manufacturer, no particular urgency is usually necessary as compared with that of the cellulose acetate manufacturer, and rather more elegant methods can therefore be employed.

Virtually all the methods in standard use are saponification methods, although distillation methods have also been developed and are said to give more accurate results.[11, 12, 13] The usual saponification method involves swelling the cellulose acetate with an organic solvent and then adding a known volume of standard sodium hydroxide solution. Under these conditions saponification takes place at room temperature, and when complete the excess of alkali is back titrated with standard sulphuric acid solution, using phenolphthalein as indicator. Among the solvents used as the swelling or dissolving agent may be mentioned ethyl alcohol, acetone and pyridine.[10] The direct use of alcoholic solutions of sodium hydroxide has also been proposed.

Among the many practical saponification methods, the writer considers the Eberstadt[6] procedure, as modified by Genung and Mallatt,[7] to give the most reproducible and accurate results, and a ±0.1 per cent. accuracy can readily be obtained. Briefly the method is as follows: Approximately 1 gram of cellulose acetate is dried for two hours at 100 degrees C. and then cooled in a desiccator and accurately weighed by difference into an Erlenmeyer flask; 40 mls. of 75 per cent. aqueous ethyl alcohol is then added and the mixture is warmed for 30 minutes at 50-60 degrees C. At this stage the acetate has swollen almost to complete solution. Exactly 40 mls. of N/2 sodium hydroxide is then added, and the whole is shaken and allowed to stand, with occasional shaking, for 24 hours. The excess of sodium hydroxide is then titrated to slight excess with N/2 sulphuric acid, using phenolphthalein as the indicator, left for a few hours and finally titrated back to neutrality with N/2 sodium hydroxide.

A quicker method, which gives fairly accurate results without trouble, is the following Dupont[9] method (quoted by Malm, Genung, Williams and Pile[8]): 1.5 grams of dry cellulose acetate is dissolved in 100 mls. of acetone, and exactly 50 mls. of N/2 sodium hydroxide is added dropwise and the mixture is then agitated for three hours. Finally, the excess of sodium hydroxide is titrated directly with N/2 hydrochloric acid, using phenolphthalein as the indicator. The "acetyl" value of cellulose acetate can be quoted in two ways; the more modern and most usual way is to express it as the percentage of combined acetic acid (CH_3COOH), but some authors still prefer to quote it as the percentage of acetyl groups (CH_3CO). This latter can be converted to the combined acetic acid content by multiplying by 1.395.

Water Content

The percentage of water in cellulose acetate is usually rather less than 5 per cent. as supplied, as it is the custom to store it before use in heated rooms; this value drops further as actually used. The water content is often determined just prior to use, in order to enable the composition of any solutions made to be kept roughly constant. Almost invariably, the determination is made by finding the loss of weight of a sample which occurs on drying in an air oven at 105 degrees C. for, say, two hours. Another method sometimes used is the Dean and Stark distillation technique, using toluene as the entrainment liquid.

Acidity

Most manufacturers and specifications state an upper limit here of .01 per cent., although present-day qualities are normally much less. Two methods are used. (1) A solution of 5 grams of cellulose acetate in 100 mls. of acetone is prepared. This is poured into 100 mls. or so of cold distilled water, the mixture is shaken, and an aliquot of supernatant clear liquid

taken and titrated with N/100 sodium hydroxide solution, using phenolphthalein as indicator. (2) Five grams of cellulose acetate is vigorously agitated overnight with 100 mls. of cold distilled water, and an aliquot taken and titrated as before. Other methods involving refluxing with distilled water for a fixed period of time actually measure the resistance of the sample to hydrolysis rather than acidity per se.

Stability Tests[15]

These vary considerably from laboratory to laboratory, and according to the specification used and the standards set up. In general, they are merely simple tests made under carefully fixed conditions, and the results compared with some arranged standard. Examples of the type of test used are as follow:—

(1) The sample is simply heated under standard conditions, and the temperature at which discoloration becomes noticeable is recorded. Alternatively, the temperature at which the colour of the sample reaches that of a given standard is noted, or the colour developed at a certain fixed temperature can be compared with a set of graded numbered standards.

(2) The sample can be heated in a high boiling plasticizer and the colour changes noted as before.

(3) The sample can be heated under fixed conditions, and its viscosity in solution then compared with an untreated sample. The more stable the sample, of course, the less effect will the heat treatment have on its viscosity.

(4) The stability to hydrolysis can be determined by heating a sample in distilled water in a sealed tube under standard conditions and the amount of acidity produced measured.

Solvents and Plasticizers

Batches of plasticizers and solvents as received are normally tested for quality according to certain specified measurements. Tests carried out can include the boiling range (usually at reduced pressure), refractive index, melting point, saponifaction value (if an ester) ash and acidity, while colour is also noted. Certain other tests are applied in specific cases; for example, triphenyl phosphate is always tested for free phenol. In addition, the water content of plasticizers is often checked by a simple miscibility test; e.g., with benzine, when a clear solution should result.

Tests necessary on plasticizers and solvents are usually simple in nature, but are invaluable in keeping a uniform quality of product; free acidity is a particularly valuable check as it can lead to greatly accelerated breakdown of the cellulose acetate surface during weathering. This is determined by dissolving a known volume of the sample in water or a mixture of alcohol and water and titrating with N/20 barium hydroxide solution, using phenolphthalein. Specifications for free acidity vary according to material, but are normally of the order of 0.02 per cent. or less for plasticizers and 0.002 per cent. or less for acetone.

Specifications for cellulose acetate and for a number of plasticizers and solvents have been laid down by the British Standards Institution, 28 Victoria Street, London, and by the American Society for Testing Materials, 1916, Race Street, Philadelphia, 3, Pa., from whom copies may be obtained.

Tests on the Finished Plastic

For the finished plastic the most usual tests are plasticizer content, water content and residual solvent; acidity is also sometimes determined.

Water content can best be determined by distilling the sample, preferably in the form of thin film with toluene for several hours in a Dean and Stark apparatus in the conventional manner. Other methods involving the loss of weight at 100 degrees C. or over a desiccant are not very accurate owing to the loss of plasticizer which also accompanies such treatment.

Residual acetone is best determined as follows: 5 grams of the cellulose acetate plastic, preferably as a thin film, is refluxed for two hours with 100 mls. of pure "acetone-free" methanol; 80 mls. of solvent are then distilled off and

collected. A 25-ml. sample of this distillate is then pipetted into an iodine flask, 20 mls. of N/2 sodium hydroxide are added, followed by 25 mls. of N/10 iodine solution. The flask is shaken and allowed to stand for 15 minutes, when 21 mls. of N/2 sulphuric acid is added and the iodine remaining is titrated with N/10 sodium thiosulphate, using starch as indicator. (1 ml. of N/10 sodium thiosulphate is equivalent to 0.000967 gm. of acetone). An exact blank is carried out on the methanol. Difficulty is often experienced in obtaining methanol with a sufficiently low blank and some workers reflux the cellulose acetate with water instead of methanol for one or two hours. This method, however, tends to give low results owing to losses of acetone during the refluxing operation. Also, for thicker samples, water seems to be less effective in leaching out residual acetone.

Plasticizer Content of Finished Product

The plasticizer content of the finished plastic is one of the most important pieces of analysis carried out in an acetate plastics laboratory, and each laboratory has its own particular method. They are all based on the same principle, however. The plastic is dissolved in a solvent, usually acetone; the cellulose acetate is precipitated by the addition of a non-solvent, followed by filtration and weighing of the cellulose acetate.

The following method gives very reproducible results: 1.0 to 0.5 gram of the sample is accurately weighed out in a 600-ml. beaker, and 75 mls. of acetone are added and left to dissolve the sample, preferably overnight. One hundred mls. of 50:50 aqueous methanol is then added very carefully with stirring; this should not result in precipitation of the cellulose acetate. Two hundred mls. of 1 per cent. aqueous ammonium chloride solution is then added as quickly as possible, when the cellulose acetate precipitates in a nice flocculent condition with no lumping. The beaker is then heated on a water bath until all the acetone is judged to have evaporated. The precipitate is then filtered off on a weighed G.3 sintered glass crucible under suction and washed with alcohol, cold water, and finally by several hundred cc. of hot water. The crucible is then dried at 100 degrees C. for three hours and weighed; this gives by difference the proportion of plasticizer to cellulose acetate. It is to be noted that the water content of the plasticizer is recorded as plasticizer by this method. It should, therefore, be estimated separately and results corrected where necessary.

Identification of Plasticizer

For the identification of plasticizers it is best to distil a large quantity of the plastic, using an oil bath under a very good vacuum at a temperature approaching 280 degrees C. The resulting distillate is then carefully fractionated in vacuo, when often a very clear separation can be effected. The highest boiling fraction (250 to 280 degrees C./20 mm.) can then be analysed quantitatively for phosphate after oxidation with nitric acid. This fraction is often found to crystallize, and a melting point of the recrystallized solid may then identify it, e.g., triphenyl phosphate melts at 45 to 48 degrees C.

Usually, on converting the results of the phosphate estimation to triphenyl phosphate, the estimation is found to substantially account for the high boiling fraction, although very occasionally a small percentage of tricresyl phosphate may also be present. The lower boiling fractions are more difficult to identify, and usually consist of mixtures of two or three different plasticizers.

Another useful check is the equivalent weight of the ester from alkaline saponification and the separation of the alcohols formed after saponification can also sometimes be effected. Similarly, the acid can be detected in the alkaline residue. The difficulty of the analysis really arises from there being usually a mixture of plasticizers, although with many commercial plastics it is often found that the bulk of the lower boiling fraction can be accounted for simply as phthalic esters. An elements test on the original plastic using metallic sodium will indicate

whether halogen (e.g., trichlorethyl phosphate) or sulphur and nitrogen (ortho- and para-toluene sulphonamides) are present, and in what proportion can be gained without too much trouble, but a complete analysis is often a very tedious piece of work, involving a great deal of careful fractionation.

(To be continued)

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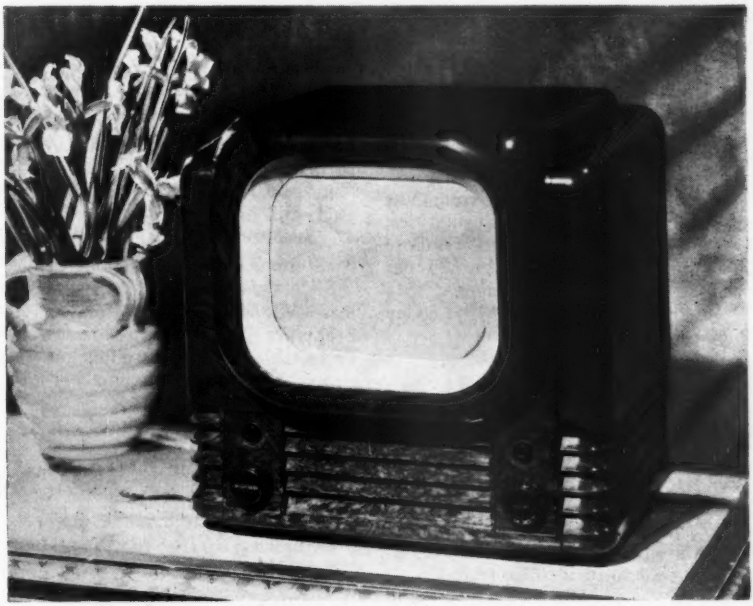


FIRST IN A NEW FIELD?

This TV. 12 Table Television Cabinet for Bush Radio Ltd., is a one-piece phenolic moulding and, we understand, the first of its kind to be produced in Europe. The cabinet was designed and moulded by British Moulded Plastics Ltd., in collaboration with Bush Radio. It was on view at the B.I.F. at Earls Court.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Plastic Replicas for Surface Finish Measurement

Sir,—The footnote to the article on the above subject, by C. Timms and C. A. Scoles ("Plastics," January, 1949, p. 24), is liable to give the impression that the method described by us (Pearson and Hopkins, "J. Iron and Steel Inst.," January and May, 1948), depends upon the curing, by heat and pressure, of a plastic material in contact with a surface under examination.

It was to avoid such a process, impossible to carry out under many practical conditions, that we developed the method of polymerizing by ultra-violet light at room temperature, a thin film of methyl methacrylate between the metal surface and a "Perspex" backing piece. This results in a robust replica, requiring no special jig for mounting, and which duplicates faithfully the surface texture and waviness of the original metal surface.

It is thus unnecessary to apply shrinkage corrections to estimates of roughness and maximum depth of irregularities, which may amount, in the cellulose acetate method, to as much as 25 per cent. for surfaces of low roughness. (See A. J. Chisholm and J. M. Lickley "Engineering," April 23, 1948.)

J. PEARSON,
M. R. HOPKINS.

B.I.S.R.A. Laboratories,
Sketty Hall,
Singleton Park, Swansea.

Cold-setting Resin

Sir,—Would you please forward us the names and addresses of any manufacturers who could supply us with a cold-setting phenol formaldehyde resin.

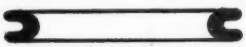
PLASTA-CRAFTS CO.

6, Brentwood Avenue, Jesmond,
Newcastle-on-Tyne, 2.

[EDITOR'S NOTE: Suppliers of cold-setting phenol formaldehyde resin are:—Catalin, Ltd., 54, Farm Hill Road, Waltham Abbey; Erinoid, Ltd., Lightpill Mills, Stroud; United Ebonite and Lorival, Ltd., Little Lever, near Bolton, Lancs. For other cold-setting resins which are not of the phenol formaldehyde type, apply to Scott Bader and Co., Ltd., Woolaston, Northants, regarding their "Marco" resins, and to I.C.I. (Plastics Division), Black Fan Road, Welwyn Garden City, Herts, regarding their "Nuron" resin.]

Grooved Rings

Sir,—I wonder if you can help me to secure a small supply of smooth grooved plastic rings, just like those used on sea fishing rods. I want them from about



1¼-in. to ⅜-in. diameter; the colour is immaterial. I would not mind them in vulcanite, but fear they might develop heat and spoil. The wall of the rings would be somewhere about ⅛ in. or 3/16 in. I am interested in these rings for both home and export. F. L. DAVIS.

11, Hill Court, St. Mark's Hill,
Surbiton, Surrey.

Film with Elastic Properties

Sir,—We are in need of a film similar to "Cellophane," but possessing elastic properties. "Pliofilm," we are told, might be suitable for our purpose, but we are unable to discover the makers of this material.

TUDOR PLASTICS.

2, Chestnut Avenue, Kettering.

[EDITOR'S NOTE: "Pliofilm" is a product of Goodyear Tyre and Rubber Co. (Gt. Britain), Ltd., Wolverhampton.]

Extruded Covering for Wood Insert

Sir,—We are seeking a plastic material which can be extruded in tubular form as a covering for a small diameter wood insert. The normal grades of p.v.c. are unsuitable as they do not appear to be sufficiently rigid to give the necessary support to the insert, which, being of only

3/32-in. diameter, is easily broken, even when covered with p.v.c.

We enclose herewith a "Hewitt" wall plug, which appears to be made of a plastic extrusion suitable for our needs (you will note that it is much more rigid than p.v.c. of similar dimensions), and we would be pleased if you could tell us the material from which it is made.

JAMES TOOL CO.
53, Kirkdale Crescent,
Leeds, 12.

[EDITOR'S NOTE: The sample is one of rigid p.v.c. of considerable hardness. This type is of pure p.v.c. more or less free from plasticizers. It can also be produced from soft p.v.c. by removal of plasticizers after extrusion. A list of manufacturers is being sent.]

Inhaler Cases

Sir,—We shall be glad if you will kindly put us in touch with a likely supplier of inhaler cases (empty) of the plastic streamlined type, for quantities of 10/20 gross.

ARTHUR H. COX AND CO., LTD.
93, Lewes Road,
Brighton, 7.

Hospital Kitchen Trolleys

Sir,—We shall be grateful if you can send us your recommendation for a plastic in sheet form for the purpose of shelves for hospital kitchen trolleys. The plastic should be suitable to withstand the heat of hot utensils and foods. It should withstand the abrasive action of utensils and crockery, and also withstand scrubbing and washing.

F. LINES.
"Globe" Metal Works,
Harlestone Road,
New Duston, Northampton.

Plating of Plastics

Sir,—I was very interested in the article by Vivian Stannett on page 261 in the May issue of "Plastics," particularly in connection with metal plating of plastics. I should like to know whether any firm in this country is carrying out this work at the present time.

ACME SHOWCARD AND SIGN CO., LTD.
Paragon Works, Green Street,
Brimsdown, Enfield, Middlesex.

"Phantom" Pack

Sir,—I will be pleased if you can give me any information on the manufacturer's and machinery maker's addresses of a prototype pack called "Phantom," which, as far as can be seen, is a drawn process using cellulose acetate.

BLAKE AND MACKENZIE, LTD.
Islington, Liverpool, 3.

[EDITOR'S NOTE: This type of pack is made by Hunt Partners, Ltd., Clapton, London, E.5.]

Pen Barrels

Sir,—We urgently need to get in touch with a plastic moulding firm who specialize in fountain and ball pen barrels.

PLASPEX PRODUCTS (LIVERPOOL).
123a, Mount Pleasant,
Liverpool, 7.

Shoe-lace Tags

Sir,—We shall be glad if you can give us names and addresses of manufacturers of a machine for attaching plastic tags to boot and shoe laces. The producers of machines employing metal tags inform us that their equipment is not suitable.

ROBERT BRYCE AND CO. PTY., LTD.
62, Finsbury Pavement,
London, E.C.2.

Name Plates

Sir,—We shall be grateful if you can tell us the name and address of the makers of "Murillo" plastic name plates.

FRANK COOPER (CANTERBURY), LTD.
2, Watling Street,
Canterbury.

Export Inquiry for Moulds

Sir,—We are interested in stock moulds, injection as well as compression, for the following:—

(1) Toys: whistles, harmonicas, flutes, tea sets, furniture, autocars, etc.

(2) Dolls, from 5 cm. to 40 cm. in height.

(3) Domestic ware, frames for eye glasses, ladies' combs, jewellery, etc.

We shall be glad to contact a source of supply.

STILAR COMMERCIAL CO., LTD.
P.O. Box 581,
Teheran, Iran.

Articles from P.V.C. Paste

Sir,—We are desirous of having a utility article of p.v.c. made by the p.v.c. paste dipping or casting process (slush process). Can you give us names of concerns who are able to carry out this technique? BENNETT PLASTICS.

53a, Sutherland Avenue,
London, W.9.

Laminated Material

Sir,—Enclosed find a small strip of material, of which we are anxious to trace a supply. We require a material such as this, but black faced, and with possibly up to five laminations—black, white, black, or black, white, black, white, black—the thickness being little more than sample supplied. We require this material for the engraving of name plates, signs, price tickets, etc. Can you put us in touch with the manufacturers?

F. SWALLOW.

44-46, Headford Street,
Sheffield.

[EDITOR'S NOTE: The sample appears to be identical with material made by Warerite, Ltd., Watton Road, Ware, Herts.]

Spinning Pots—Weaving Material

Sir,—In the April issue of "Plastics" (page 197) I notice brief mention of moulded spinning pots, as used in the textile industry. I would be obliged if you could forward me the address of the makers.

Also, does any English firm produce plastics threads suitable for the weaving of upholstery cloth, similar to the American "Saran." LEON TOCH.

Quai des Tanneurs, 23.
Gand, Belgium.

[EDITOR'S NOTE: The spinning pots to which our correspondent refers are moulded by Ashdowns, Ltd., Eccleston Works, Knowsley Road, St. Helens, Lancs. With regard to the second query, "Bexan," which is made in England by BX Plastics, Ltd., Larkswood Works, Higham Station Avenue, South Chingford, London, E.4, resembles the American material "Saran." A polyvinyl chloride thread suitable for similar use is made by Clutsom and Kemp, Ltd., Highfields Street, Coalville, Leicestershire.]

Electroformed Moulds

Sir,—We have read with particular interest the article "Hard Nickel Electroformed Moulds," by P. Spiro in the March, 1948, issue of "Plastics" (pp. 132-136).

Being very much interested in the new process of plastic moulding, we should be glad to know Mr. Spiro's address, in order that we may get in direct contact with him. STEEN AND ZECH.

Zurich 10,
Am Wasser 55.

[EDITOR'S NOTE: Mr. Spiro's address is, c/o London and Scandinavian Metallurgical Co., Ltd., Chelton Works, Gonsalva Road, London, S.W.8.]

Polythene

Sir,—We are anxious to contact the makers of a plastic material known as polythene, which has been recommended to us for use in connection with our thermal urns.

W. J. HUBBARD AND SONS, LTD.

7-10, Occupation Road,
Manor Place,
Walworth, S.E.17.

[EDITOR'S NOTE: Polythene is manufactured under the name of "Alkathene" by I.C.I., Ltd. A list of moulders has been sent.]

Laminated Sheet

Further to our reply to Modern Commodities, Ltd., regarding manufacturers of laminated sheet, we omitted to mention the important types "Panilax" and "Paxolin," manufactured by The Micanite and Insulators Co., Ltd., of Empire Works, Walthamstow, London, E.17. "Panilax" is an aniline-formaldehyde resin bonded paper laminate, while "Paxolin" is a phenol-formaldehyde bonded paper laminate.

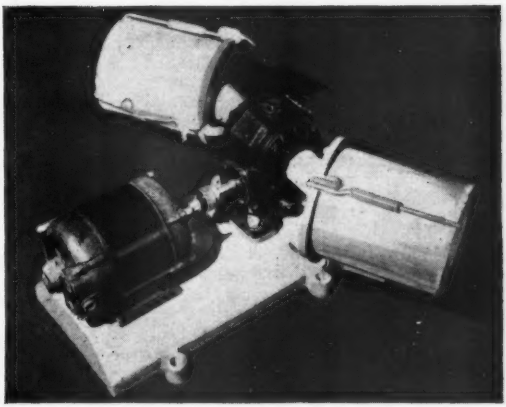
Plating Mould Products

In the "Editor's Note" to a letter under the above heading ("Plastics," April, 1949, p. 213) the address of Metaplast (England), Ltd., should have been given as Bath Road, Harmondsworth, West Drayton, Middlesex. Their telephone number is West Drayton 3001. The address previously given, Great North Road, Ferrybridge, York, is that of their associate company, Whitehouse Industries, Ltd.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

MIXING MACHINE.—This "Wobble Mixer" is claimed to be a very versatile machine. Containers are easily clamped to it and rotated in a manner similar to that of a cocktail shaker. Tests have shown that the principles of the machine are sound and that they provide very efficient batch mixing. The model illustrated will accommodate two containers each of one gallon capacity; another design will accommodate one 5-gallon container in a cradle between two roller-bearings.



The important feature incorporated in this machine is that the containers are loaded separately, and therefore there is no hold-up to load the machine. The ends of each container describe an out-of-phase rotation, so that contents are thrown axially and radially with a change of direction every half-revolution. There are no "blind spots" and a thoroughly homogeneous mixture results. Power is only used to overcome friction and to intermingle contents; no power is wasted in blade friction. The power used is about one-half that of blade-type mixers. Rotating parts are sufficiently balanced to eliminate vibration. Capacities are available from 1 to 40 gallons.

BELGIAN PLASTICS EXHIBIT.—The Second Salon des Matières Plastique is being held in Brussels, at the Palais du Centenaire, until June 26. It is the only Continental exhibit devoted purely to plastics, and will cover raw materials, mechanics of production by compression, injection, extrusion, welding, pre-heating, etc., and finished and half-finished goods. It is being organized by the Office Belge des Matières Plastiques, 153, Chaussée de Bruxelles, Bruxelles-Forest.

FURNITURE DESIGN.—A conference on furniture design, organized by the Council of Industrial Design, will be held July 18-22 at the Royal Institute of British Architects, London. Papers addressed to the scientist and technician, manufacturer and distributor, as well as to the designer, will be given by representative experts on some of the factors governing design, such as the scientific, social and economic aspects; architectural setting; modern and traditional materials; hand and machine methods; distribution; and training of designers. An open discussion forum will provide an opportunity for questions to be put to those contributing papers.

The conference is free, but formal enrolment is necessary. Those interested should write, briefly indicating their professional or trade interest, to the Council of Industrial Design, Tilbury House, Petty France, London, S.W.1, marking their letters "Furniture Design Conference."

"PANILAX" INSULATION.—The Micanite and Insulators Co., Ltd., have sent us a copy of their recently published brochure on "Panilax" laminated sheets, moulded laminated bars and resin mouldings. "Panilax" is the company's registered name for materials embodying an aniline-formaldehyde resin. The electrical characteristics of both laminated and moulded forms make them particularly suitable for use where space is restricted or a greater factor of safety for the electrical performance is desired. Although the actual resin is thermoplastic, its plastic yield temperature is high, and materials based on it may be used at temperatures up to 90 degrees C. without deformation. Apart from technical data on laminated insulation and the moulded resin,

this brochure gives three very useful pages regarding the machining of "Panilax." Both laminate and moulded forms are relatively good heat insulators, so that when they are machined care must be taken to reduce local heating to a minimum; otherwise inherent stresses may be produced. The moulded resin (without filler) is resistant to alkalis in the usual industrial concentrations, and is unaffected by water, organic solvents and hot oil; compared with phenolic-type resins, it has greater resistance to "tracking" when electrically stressed. The brochure is printed in colour, and is uniform with the company's previous publications. Copies may be obtained on application to The Micanite and Insulators Co., Ltd., Empire Works, Walthamstow, London, E.17.

BX PLASTICS, LTD.—A recent publication of this company outlines briefly the use of p.v.c. in engineering, furnishing, food production, electricity, mining, chemistry, footwear and railways, and is certainly worth perusal. We are told, for example, that the scruff resistance of this material adds months to the life of miners' boots, especially in narrow coal seams; that as an engineers' bench covering, the hard wearing and cushioning properties of p.v.c. not only protect the surface of the bench but likewise protect work and tools; that no other material by comparison with p.v.c. stands up so well to the action of a stream of shot or sand in shot-blast cabinets. Nine other outstanding instances of usage are detailed. A copy of this leaflet can be obtained by any of our readers on application to BX Plastics, Ltd., Higham Station Avenue, London, E.4.

I.C.I. PLASTICS DIVISION.—Dr. J. E. Sisson has been appointed delegate director responsible for sales on the Board of I.C.I. Plastics Division, as from June 1, 1949. Dr. Sisson has been plastics regional sales manager, Southern Region, since October 1, 1947. His place as sales manager will be taken by Mr. A. R. Milne, who, until June 1, was manager of Home Sales Control Department, I.C.I. Plastics Division, Welwyn Garden City. He will be replaced by Mr. J. Hargreaves, formerly deputy plastics manager, Southern Region.

CHEMICAL RESEARCH LABORATORY, D.S.I.R., at Teddington, Middlesex, is again holding a series of "Open Days" this year. There will be three sessions, June 30 (afternoon), and July 1 (morning and afternoon). The Director will be glad to receive (until June 20) applications from industrial firms wishing to send representatives. It is not necessary for those already on the invitation list to re-apply. The main branches of research are corrosion of metals, organic chemistry, inorganic chemistry, radiochemistry, and high polymers and plastics.

MONSANTO CHEMICALS, LTD.—On May 20, the new research laboratories of Monsanto Chemicals, Ltd., at Ruabon, North Wales, were officially declared open by Sir Ben Lockspeiser, secretary of the Department of Scientific and Industrial Research. At a subsequent ceremony performed by Mr. T. P. Berington, director of Monsanto Chemicals, Ltd., the laboratories were named The Nickell Laboratories, in honour of Dr. Lloyd Francis Nickell, chairman and managing director of the company from 1930 to 1948. The new laboratories are described in an illustrated brochure which the company has published.

BX PLASTICS LTD. have appointed Mr. R. Maitland as general sales manager and Mr. H. J. French as deputy sales manager.

EVOLITE PLASTICS, LTD.—Our reference to this exhibit at the B.I.F. ("Plastics," May, 1949, p. 258) should have read: "Tubes of welded 'Perspex' for industrial uses"; not "cellulose acetate," as there given.

DR. GEOFFREY SWANN, manager of the Chemical Division of the BX Plastics Ltd. Research Station, Lawford Place, Essex, has been appointed research manager to Beck, Koller and Co. (England) Ltd., at Speke, near Liverpool, as from June 1, 1949. Dr. Swann has been with BX Plastics Ltd. since 1938.

MR. H. J. JUDD retired from office as hon. secretary of the London and District Section of the Plastics Institute on June 2.

PLASTICS INSTITUTE NOTES

Training Grants, 1949

The Trustees of the President's Fund of the Plastics Institute invite applications from young men or women engaged in the plastics industry, for a limited number of Training Grants of £100 per annum for one year to cover all expenses, including tuition fees, which may be increased at the discretion of the Committee in special cases, the onus being upon the candidate to find a suitable college willing to admit him or her.

These grants are for full-time courses of one year's duration, for technical training covering Inter. Subsidiary or intensive Final B.Sc. courses in pure and applied mathematics, physics and chemistry, or an intensive

course for a Diploma or National Certificate in mechanical and electrical engineering.

Applications for these Training Grants must be submitted in writing to the Managing Secretary, The Plastics Institute, The Adelphi, Adam Street, London, W.C.2, by June 15, 1949.

Annual General Meeting and Luncheon

Following the annual general meeting of the Plastics Institute, which is to be held on Wednesday, June 22, 1949, at 12 o'clock noon, at the Dorchester Hotel, Park Lane, London, W.1, there will be a luncheon at 12.30 p.m. for 1 p.m. The guest speaker will be the Rt. Hon. James Harold Wilson, M.P., President of the Board of Trade. Accommodatioin is limited, and admission will be by ticket only. Applications for tickets should be made to the Hon. General Secretary, The Plastics Institute, not later than Wednesday, June 15, 1949, together with a remittance of £1 5s. for each ticket.

NOTES FROM BRITISH PLASTICS FEDERATION

New Members

PLASTICS MATERIAL MANUFACTURERS' GROUP: J. B. Broadley, Ltd.

MOULDERS' GROUP: C. Hughes and Co., Ltd.

FABRICATORS' GROUP: Hill, Norman and Beard Plastics, Ltd.

British Industries Fair

Over 900 inquiries were received and answered at the Federation's stand in the Plastics Section at Earls Court. Many of these referred to sources of supply or manufacture, and names of appropriate member firms were given to the inquirers.

S.P.I. Film

Through the courtesy of the Society of the Plastics Industry, New York, the film, "A Scientific Approach to Better Plastics," has now been received in this country. Arrangements have been made by the Federation for the film to be shown by the Plastics Institute to those interested in the industry. This highly technical film describes fundamental research on the testing of plastics materials which is being carried out at the Massachusetts Institute of Technology, Cambridge, Mass.

Glossary of Terms

The Main Technical Committee and Technical Committees of the different groups of the Federation have co-operated in the preparation of a "Glossary of Terms Used in the Plastics Industry." It is believed that this is the first really comprehensive glossary of this type to be published in any country. Copies can be obtained on application to the Federation, price 10s.

Wear and Tear Allowances

As a result of representations made by the Federation, the Board of Inland Revenue has now amended the Wear and Tear Allowances. The allowances for plant used in plastics manufacture in future will be as follows:—

Up to but excluding double shift working ...	10 per cent.
Double shift working or more, but excluding treble shift working ...	12½ per cent.
Treble shift or continuous working	15 per cent.

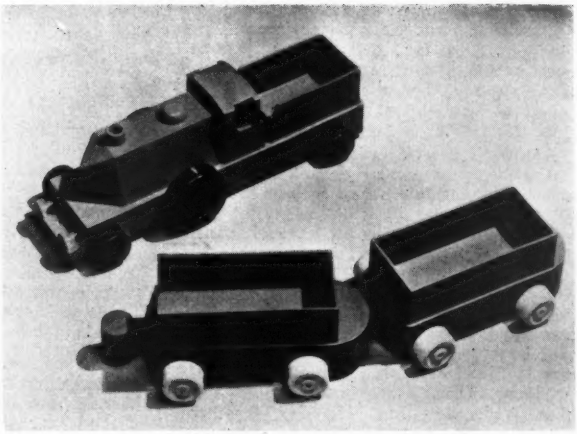
This arrangement is applicable for 1947-48 and subsequent years, but District Inspectors of Taxes have been informed that where Wear and Tear Allowances for 1947-48 and 1948-49 have already been settled on a basis of the previous arrangement, they need not be revised, except at the taxpayer's request.

Flaws in Steel Blocks

As is well known, serious loss may occur from time to time through flaws present in steel blocks. Such flaws may not be found until a mould is almost completed, with consequent waste of time and delay in delivery of the finished mould, and waste of work. The Federation has recently taken the matter up with the Iron and Steel Federation with a view to overcoming this trouble.

P.I.G.S.—The Plastics Institute Golfing Society held a golf tournament at Moor Park on the morning of May 25. The occasion was for the final of the British Plastics Trophy, which was won by Mr. Percy Smith, of Bakelite, Ltd., and presented by Mr. C. E. Wallis, chairman of Iliffe Associated Press, Ltd. The runner-up was Mr. M. O. Bamberger (British Artid Plastics, Ltd.). In the afternoon, the match for the Austerity Cup was held, this cup being won by Mr. T. S. Crabtree. This match (with wooden cup to commemorate the start of the petrol ration !) was started by Bakelite, Ltd. The present cup was presented by Mr. H. Brooke, of British Artid Plastics, Ltd. Coupled with the cup was a barometer, donated by Mr. R. Hartley, hon. general secretary of the Plastics Institute. Mr. R. E. Dangerfield, chairman and managing director of Temple Press Ltd., was not present at the tournament, but attended the dinner at Grosvenor House, London, in the evening.

New Productions from the Moulding Shops



Toy Train Set

This colourful, strong and beautifully finished train set is moulded from "Scarab" wood-filled urea - formaldehyde moulding powder. It is one of the many attractive toys marketed by The Chad Valley Co., Ltd., Harborne, Birmingham, 17, who assemble and finish the various components which are moulded exclusively for them by a number of plastics moulding companies. The different parts of this toy are in different colours, the assortment being red, blue, green and orange. Contours have been rounded, wherever possible, without too great a departure from realism; there are no sharp edges or dangerous projections to cause injury to the child.

Charity Box

This collection box for the Royal Air Force Benevolent Society, in addition to its plastics interest, has a certain aspect of novelty about it. It holds a bottle of "Ronsonol" lighter fuel, from which a lighter can be filled by means of a special dispenser, in return for which a donation is made to the fund, hence the slogan "Take a Little Give a Little."

The box is moulded in four parts in cellulose acetate; the body, which weighs some 9½ ozs., being produced on an 8-oz. Reed-Prentice machine. The other three pieces consist of the base, partition, and badge, and when these are all brought together a strong and attractive assembly results.

The dispenser is a good example of p.v.c. moulding, and incorporates both a rigid and flexible grade, each moulded in a four-cavity tool. By pressing the bulb portion an adequate supply of fuel is obtained, the flow of which ceases, when pressure is removed, without dripping.

A production of J. F. Kenure, Ltd., Feltham, Middlesex, all moulds were designed and made in their own tool room.

The box is distributed to hotels, clubs, restaurants, etc., by H. Gilbert Cooper (Enterprises), Ltd., 20, Notting Hill Gate, London, W.11, on behalf of the R.A.F. Benevolent Fund; the dispenser is supplied by Weston Patent Utilities, 12, Bolton Gardens, Teddington, Middlesex.

Ball-bearing Cage

In our issue of January, 1949 (page 39) we published a photograph of a ball-bearing cage moulded in shock-resisting fabric-filled "Bakelite." Our present illustration shows a similar cage made from laminated material, the two halves being riveted

SEEING BEES WITH EASE

Versatile 'Perspex' plays yet another part! In the Stanley Observatory Hive its lightness, strength and transparency are utilised to provide a hygienic home for bees where they can be watched without being worried. This is a practical help for student apiarists, and agricultural colleges.

"PERSPEX" ACRYLIC SHEET

IMPERIAL CHEMICAL INDUSTRIES LIMITED

ICI

P.331

THE MARK OF A NATIONAL PLASTICS COMPANY

moulded thermoplastics

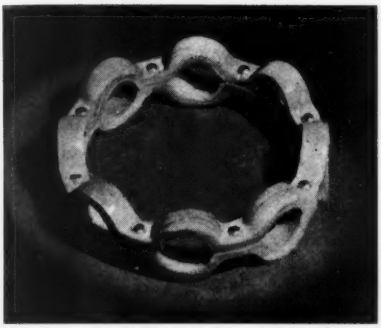
—*where only plastics will do*

The Deedon Inhaler effects extreme atomisation of inhalants for the relief of asthma and other respiratory complaints. To achieve this result, and to produce a light-weight, non-fragile instrument that no inhalant will corrode, five plastic parts are moulded from cellulose acetate and polystyrene materials. Moulds and mouldings made for Moore Medicinal Products Ltd., by

BRITISH MOULDED PLASTICS LTD.
AVENUE WORKS • WALTHAMSTOW AVENUE • LONDON • E 4

Photographs reproduced through the courtesy of Moore Medicinal Products Ltd.

BM 123



together. This example, which measures 2 ins. in diameter, and accommodates eight ⅜-in. balls, was exhibited on the "Plastics" Stand at the B.I.F. by courtesy of the Skefko Ball Bearing Co., Ltd., of Luton.

"Ducky"

This article of utility for small children is really of novel design. It is moulded, with the head of the duck as a detachable handle. It was shown at the B.I.F. by Roy Aitken and Co., 48, Dundas Street, Glasgow, C.1, patentees and sole proprietors, being made to the general design of Mr. Roy Aitken. Tools were designed and made by Aeroplastics, Ltd., of Earl Haig Road, Hillington, Glasgow, S.W.2. The body of the duck is moulded in a 350-ton press, employing a two-impression mould. The head is moulded

on a 150-ton side-ram press with a four-impression mould. The moulding powder used for both parts is "Scarab." Painting (eyes and beak being of different colour) and assembly are also done by Aeroplastics, Ltd.

P.V.C. Industrial Gloves

Glove manufacture is now one of the chief activities of James North and Sons, Ltd., of Godley Mills, Hyde, Cheshire. Their unrivalled experience of trade users' needs has now culminated in the manufacture of fabric-supported p.v.c. gloves, which are the

subject of a patent application. Intensive tests under actual working conditions, carried out by co-operation with I.C.I., Ltd., have established that these p.v.c. products are up to 12 times more resistant to abrasion than any others, being far better than the toughest leathers. In addition, they are chemically inert and unaffected by acids, alkalis, fats, greases, oils, spirits or waxes; they are also non-ageing, non-oxidizing, non-inflammable and possess excellent water resistance. The gloves, as also mittens and one-finger mittens, are seamless; the interiors are made of special sweat absorbent material. They are available in five lengths and four sizes, and are made with either rough or smooth finish.

Translucent Tarpaulin

A bad-weather tarpaulin for telephone line crews is made of heavy-gauge "Vinylite" sheet. It protects workmen from wind and rain and at the same time lets in daylight. It is thrown over the telephone lines, and does not set up disturbances. Plastic Sheeting Co., 1205 S.E. Grand Avenue, Portland 14, Oregon, U.S.A., are the producers. ("Business Week," 1949/May 12/60.)

Testing and Proving Injection Moulds Prior to Production

By W. M. Halliday

Continuing from our May issue, the author deals mainly with the difficulties confronting the small works.

AS a general rule, medium-sized and smaller moulding concerns can neither afford the capital outlay in machines and equipment nor the personnel necessary to operate testing departments successfully and prove moulds in the orderly manner already outlined.

The usual mould testing or proving practice adopted by such smaller moulding works consists of condensing the operations into as short a space as possible at the *outset* of the *first production run.*

In such circumstances it will be restricted to the moulding of a few samples for checking dimensional variations from the drawing or customer's sample part. Once the mould has been adjusted to produce correctly sized components, these will be inspected and sent along to the client, usually with some such qualifications that surface finish and general appearance will be improved later when bulk quantities are produced.

The mould will then continue in use, the while altering runners or gates to secure better feeding, and adjusting ejectors or cores to permit mouldings to be removed from the mould without distortion or damage. Errors in design or construction will also be sought and corrected.

Meanwhile, the injection machine is tied up on such proving work, and if the pressure of other moulding orders is heavy there will be inducement to proceed with production before the mould has been completely checked and verified on all the points already outlined at the beginning of this article.

Should this latter course be adopted, production is almost sure to be characterized by frequent stoppages to effect some adaptation or modification to the mould mechanism.

Much of the information and operating data, which it has been noted earlier is essential for efficient operation of the moulds, will be absent at the beginning of a production run started off in the manner described above, and will have to be *derived by trial and error and consequent delays throughout at least the early stages of the production working of the injection machine.*

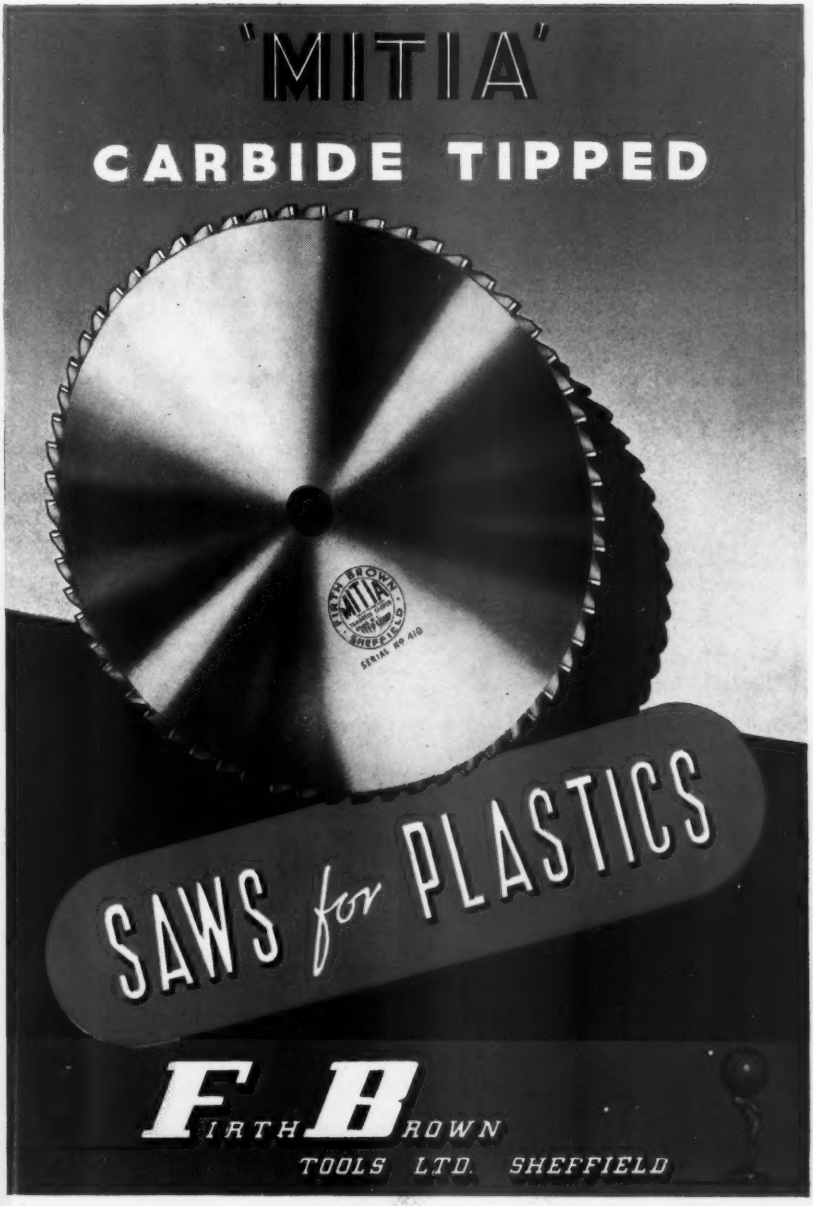
Elimination of Unnecessary Activities

The question will be raised as to what other course is open to the small moulding works not able to afford setting up a distinct department with its staff devoted solely to the proving of new moulds. To answer this legitimate query, the writer would like to describe one method which has worked very well indeed in just such a modestly sized works unable to install a specialized department for such duties.

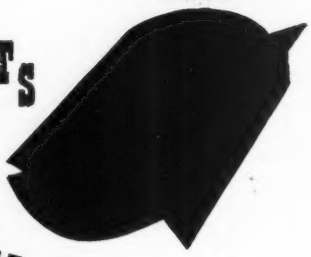
A preliminary careful analysis of the time usually absorbed by new moulds of size and type manufactured when proving revealed that approximately two whole working days were required to make a satisfactory job.

It was found that the capacity of the toolroom was to produce one new mould every two weeks, the practice being to test such a tool and commence production as quickly as possible thereafter. This meant that a new mould had to be proved once every couple of weeks, involving on an average the use of an injection machine for two full days.

It was found upon investigation that the two days period could be very drastically reduced by the provision of drilling jigs for locating certain holes on


'MITIA'
CARBIDE TIPPED
SAWS for PLASTICS
F B
IRTH ROWN
TOOLS LTD. SHEFFIELD

ODD REQUIREMENTS



ARE ALL TO OUR TASTE

Perhaps fish-faced plastic sections mean nothing to you. But something just as out-of-the-ordinary might 'put paid' to *your* particular production snag.

You may not have to look beyond the standard Tenaplas ranges (applications: from trimmings to television; lamp-shades to giant liners). But should you conceive some undreamed-of use for Tenaplas, our resources and experience are at your call. Shape, colour, length, size (down to the finest limits), as you wish.

In one thing only Tenaplas never varies — its wealth of advantages. Included are: flexibility with toughness and great tensile strength; clean, smooth finish; unaffected by temperatures from −20° to +75°C; resistance to oils and most acids; constant electrical insulation; non-inflammability . . . and with what ease it responds to High Frequency sealing and welding! Difficulties diminish when you call in Tenaplas.

★ *All types of industries are using Tenaplas to-day—often in rather unexpected ways. For instance, new uses found for Tenaplas include: dividing wires in the IMHOF gramophone record holder, spray reduction in electro-plating bath, covering storm rails on the "Queen Mary." Tenaplas is also used extensively in the new Hermes IV aircraft.*

Tenaplas

THE NAME TO REMEMBER FOR **FLEXIBLE** (AND RIGID) **PLASTICS**
IN ANY CONTINUOUS LENGTH, SHAPE OR COLOUR

TENAPLAS LIMITED, 78, BUCKINGHAM GATE, LONDON, S.W.1

Phone: Whitehall 8735, 8736, 8737. Cables: Tenaplas, Sowest, London. Code: Bentley's, 1st Edition Agents throughout the world

T.P.14A

the mould blocks, which formerly had to be marked off from the machine platens or other portions of the machine.

Thus block-fixing holes, sprue pull-out rod-guide holes, ejector-box fixing-screw holes, and the like, were all usually marked off directly from the machine, involving almost a complete mounting of the mould in order to mark off such locations, etc., and then removal of the mould for machining, followed by a second mounting.

Jigs were provided for accurately positioning such holes without mounting on the platens of the machine at all, thereby eliminating a very considerable amount of time. This work was then performed in the toolroom before the mould was issued for proving.

Further, by strict adherence in the drawing office and toolroom to a policy of using standard screw diameters and lengths, standard studs, thread forms, and so forth, another substantial reduction was made in the time needed to get the mould ready for mounting on the machine. Sets of standard screws were kept available at every injection machine, so that the toolmaker had not to search around the works for suitable screws, studs, nuts, clamping straps, plates, etc., or wait until unusual sizes of these items were made up before a mould could be mounted.

Approaching the problem from this angle and working along similar lines to those just described, it became possible to reduce the two days by practically 50 per cent., which was in fact the figure aimed at, because this was the maximum permissible time which it was considered any of the production injection machines could be spared specifically for proving moulds as distinct from their normal functions.

The progress of the orders through the moulding production department was then carefully arranged so that at least one of the six injection machines available completed one order or part order per fortnight. Times of mould manufacture in the toolroom were also carefully estimated and progress closely watched so that deliveries of new moulds were made to coincide as near as practicable with the dates for changing routing orders on the moulding machine shop.

Thus, with careful organization and close personal supervision of these two aspects of the works activity, it became possible to arrange mould manufacture and completion to suit the termination of a particular moulding order and the resultant freeing of a machine to allow trials of a new mould to be carried out. Sometimes it proved more advisable to arrange this from the other end, viz., that to empower a longer or shorter production run to a prevailing order on the production shop to suit an alteration in the time for completing a new moulding tool.

Readers will now appreciate how this problem may be largely overcome in the the small works, which is simply by the provision of small and inexpensive items of equipment, such as jigs, etc., greater standardization, improved methods and closer co-operation and organization between the production and toolmaking sections of the works.

Of course, it must be admitted that a serious delay, say, in the toolroom in respect of the intended completion of a mould, did sometimes occur. If such a delay resulted in the mould test and proving being desperately urgent when eventually the mould was finished off in the toolroom, a break into production had to be made. Such interruptions were, however, very rare.

Organization of Proving Operations

A mould setter and a moulding shop charge hand were deputed for making all tests on new moulds and were clearly acquainted of the organization and planning involved in securing one whole working day at some point during a two weeks' period for this purpose. They were urged to take every step to facilitate these proving operations, which were accomplished very well along the following lines:

Firstly, they were made personally

responsible for ascertaining the date on which the try-out would be made, as this, of course, varied with each bi-weekly period. This obviated a good deal of uncertainty and oversights.

Secondly, they were instructed to follow-up immediately the ending of a production order on the machine chosen for testing a new mould and to commence at once the task of changing over. This avoided those more or less lengthy waits in between the ending of a moulding operation and the setting-up of the new mould for testing.

Thirdly, all the necessary tools, gauges, drawings, etc., required for mounting, setting and operating the mould, and the later checking of the finished mouldings were to be collected before commencing to install the mould so that no delays were occasioned.

Fourthly, inspection of the moulded parts produced during such tests was to be carried out by the works inspection department and a written report made out.

Fifthly, any errors, omissions, or obviously required alterations to the mould or auxiliary tools observed by them during proving operations were to be reported at once to the designer or toolroom, as deemed necessary, so as to avoid delays in determining, sanctioning and completing any modifications, etc., to the mould.

Sixthly, where possible, all alterations, adjustments or corrections were required to be performed by the persons charged with making the mould tests. Here again delays were largely avoided.

Seventhly, when each mould to be proved was nearing completion of construction, the individuals charged with conducting the proving tests were charged also with the responsibility of making themselves familiar with the design, constructional and operating details. It was found that by insisting upon a prior acquaintance with this information before the mould was issued for proving, much uncertainty and subsequent investigation as to how the mould should be worked was eliminated.

Eighthly, in similar manner, careful study had to be made of the moulded component drawing or the customer's sample part in order to ascertain the most important points to be secured and the manner in which they could be best obtained. This action also considerably promoted reliable and straightforward proving by helping to avoid guesswork and misconceptions as to the client's precise requirements.

Improved Organization

By concerted and better planned activities of the above nature, not only at the immediate proving stages, but well in advance, it was found possible to reduce the time required for such tests practically down to the bare minimum needed to install the mould on the machine and to run off the necessary components. This was performed very expeditiously and without in any way impairing the efficiency or reliability of the operations.

Analysis of mould proving operations in many small works will undoubtedly reveal that the length of time occupied in testing a mould in readiness for production is highly disproportionate to the other vitally necessary activities. Very often this side of toolroom and moulding-shop activity is ill-planned in the extreme.

Improved organization of the kind just discussed would go far towards effecting economies by not only reducing proving times and simplifying such operations, but also in preventing costly and protracted hold-ups in the normal day-to-day production.

Even with works of modest size and means much can be done along the lines here suggested to secure some, if not all, of the advantages ensured by the large concern by instituting specialized proving and testing methods in a distinct department set aside for such duties. It is hoped that what has been discussed in this article will serve to focus greater attention upon this aspect of the moulding-shop activities and assist those wishing to place such essential operations upon a more orderly basis.

The Microscopic Examination of Plastic Materials

VII.—Mouldings (Contd.)

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

IN discussing the structure of the large wood particle situated in the black portion of the section under examination ("Plastics," May, 1949), it was pointed out that the density of the filling varied even in a single tracheid, and that there were also distinct indications of the presence of minute pigment granules in the material filling the tracheid, although it was impossible to be sure that individual grains existed as such. It is now proposed to examine further the structure of this particle.

The particle in question is illustrated at 500 diameters in Fig. 394, from which it can be clearly seen that the density of the filling is very variable. The possible reasons for the occurrence of this phenomenon are not immediately apparent, but it is probable that, owing to the irregular cross-sectional area, various frictional effects come into operation during the filling of the vessels. For example, we may consider the case of the large central tracheid A; the lumen in this case is long and narrow in section owing to a considerable collapse of the cell wall.

As previously pointed out, during the study of the structure of the soft woods, the tracheids are almost square or rectangular in section, and the only method by which filling may occur is by the resin entering from the ends. If we now assume that initially the tracheids of the particle were empty of resin, that is, filled only with air, then during the moulding cycle the particle could be subjected to considerable pressure, presumably in the directions shown by the arrows B, for a short time during the transition of the resin from the solid to liquid phase. Before the resin becomes liquid enough to flow with the ease necessary to fill a structure such as this, it must certainly pass through stages of progressive softening to the fluid condition. In a case such as that under consideration where the structure is initially empty, it would appear quite possible that collapse occurred as soon as the mass was soft enough to give way under the influence of the mould pressure.

Assuming this to be the case, then a consideration of the immediately ensuing events is indicated. Thus, having softened the resin sufficiently for movement to occur in the mass of powder granules, a certain degree of compression is experienced before liquifaction occurs, bringing about collapse of the structure.

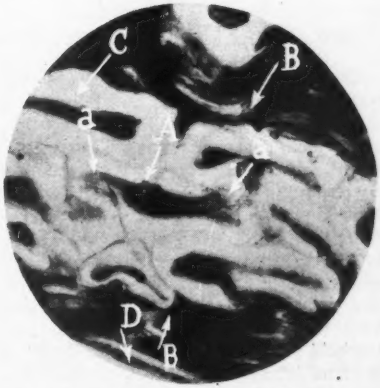


Fig. 394.—Large wood particle in black portion of old moulding. Mag. 500 diameters.

Assuming again that liquefaction follows rapidly on the initiation of the plastic phase—which it undoubtedly does under the influence of the heat and pressure in the mould—then it is apparent that the structure requiring to be filled will already be partially collapsed and the cross-sectional area of the tracheids will, of course, be of irregular shape.

From this it follows that resistance to the flow of resin in the bore will be variable, thus making filling easier in some parts than in others, for example, those portions of the section of the large central tracheid marked A, where the contour would probably offer greater resistance to the moving mass of resin than the more open central portion of the lumen. In spite of this, however, the tracheid in question is seen to be quite full and even the tiny pit channel connecting the right-hand end of this unit with the lumen of the unit situated somewhat above and to the right of the one under discussion. In this case, likewise, the bore of the unit is seen to be filled but the density varies, the portion of lowest density being in the pit channel where the friction may be expected to be highest.

As against this the density of the contents of tracheids which do not exhibit such distortion of the lumen is seen to be less variable; thus element C, although having suffered through collapse, does not appear to have experienced the violent convoluting of the walls of the lumen as seen in the elements just discussed; instead, the lumen in transverse section tapers more or less evenly from right to left, the net result being a corresponding tapering in density in the same direction. The most dense portion is at the end of greatest area, while the lowest density occurs at the left-hand end of the section, which is also the narrowest and therefore offering the greatest resistance to the liquid resin. The isolated tracheid seen in longitudinal section at D is of no interest as it illustrates the complete filling of the elements in this moulding.

The presence of pigment granules in

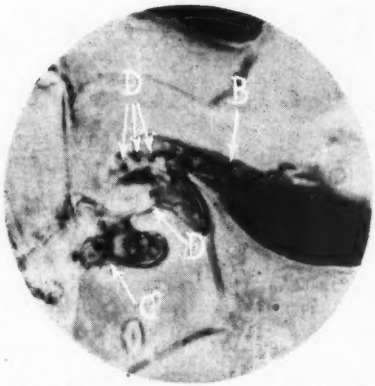


Fig. 395.—Section of black portion of old moulding. Mag. 1,200 diameters.

the resin filling the bores of these vessels is only at present in the nature of surmise, as the only indication of their existence, so far, is the appearance of a structure in the resin, and as the structural units visible are very small, one can only guess at their probable origin. Although they suggest pigment granules, it is quite possible that the structure may be due to the presence of innumerable bubbles of very small size; but in view of the knowledge of the capacity and colour of the portion of the section under examination, the possibility of the structure being composed entirely of bubbles is the less likely of the two, for it is reasonably certain that the material is pigmented.

However, in view of the magnification of Fig. 394, it is quite obvious that the pigment granules present in this area are very minute in size, therefore it is necessary to examine this structure at a still higher magnification as exemplified in Fig. 395, where the left-hand end of the lumen of the large central particle is seen at a magnification of 1,200 diameters. From this illustration it will be noticed that in the extremity of the lumen, the filling is much less dense than that in the middle; as a result of this it is possible to distinguish individual pigment granules, such as the three illustrated at D. It is, however, only by virtue of their relatively

This illustration shows bench work in progress on the main die portion for moulding a Reel Spider, used in the textile industry. A small conically-shaped plug fits into the large round plug in the foreground, forming the lower coring and punch centralising plug. Moulded ribs are formed in the slots shown on the main piece.

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wide separation that these particles become visible, as they are under one micron in diameter and are separated from each other by a distance greater than their diameter. In cases where this separation distance is less, such as the spot marked B, the images of the particles tend to run into one another, with the consequent loss of visibility; likewise at the centre of the lumen where the pigment is dense, it is impossible to distinguish individual particles.

From the foregoing it becomes apparent that the pigment used in this resin is fine indeed, and also that, due to the absence of obvious agglomeration such as has already been examined in a modern moulding, the pigment distribution is only affected by factors such as the irregular contours of the internal walls of lumens in those cases where the particle has collapsed prior to being filled. The influence of such conditions is purely mechanical, inasmuch as frictional effects appear to become operative in these circumstances, it is doubtful if much filtering of the pigment particles occurs, as they are so small in relation to the average lumen encountered that only the presence of large pigment agglomerates is liable to cause blocking at the entrance and subsequent filtering of the resin into the bore.

There are, however, occasional locations in the structure where filtering occurs, such as in the very fine pit channels; one such example seen in that connection is the lumen of the small element C to the large one being discussed. The channel is shown at D, and it is quite evident that it is filled with resin, but no pigment particles are present.

It is due, on the one hand, to the fineness of the pigment and the fluidity of the mixture on the other, that the impregnation of these particles is so complete. The mobility of the resin and pigment might be achieved by very thorough mixing of the pigment and general considerations of the structure of this portion of the moulding points to this being the case.

In the examination of this black material, there have so far been no indications of the presence of bubbles; this is probably due to the pigment, for it has been shown, when dealing with the moulding produced from a two-part powder, that whereas the pigmented portion contained no bubbles capable of detection, the unpigmented parts of the material contained them in large numbers. From this it was concluded that the pigment was instrumental in preventing bubble formation. In the present case the same argument would appear to apply, as no bubbles have been detected as yet. It is, therefore, logical to suppose that if the assumption is true, and the pigment does, in fact, function in this manner, then in cases where this latter has been filtered, due to very small bores, one may expect to find bubbles in the resulting mass of clear resin.

Fig. 396.—Section of black portion of old moulding. Mag. 1,200 diameters.

The structure, consisting as it does in the main of fairly large well-impregnated wood particles, together with a proportion of individual tracheids and dust, makes it difficult to find an example of this type of phenomena, as the general rule is a complete filling of the structures whose cavities are not usually small enough to filter the pigment. The only likely location for this occurring is exemplified by the single tracheid shown in Fig. 396 at a magnification of 1,200

diameters. The lumen of this unit is quite filled with resin, but no pigment is present, in spite of the fact that the diameter of the bore is considerably greater than that of the average pigment particle. This is due chiefly to the constriction at the end of the unit marked A being brought about by the bending of the tip. The other end of this tracheid (not seen in the photograph) was constricted by a sudden decrease in diameter so that filtering was unavoidable.

This condition is not often met with in softwood elements as a natural occurrence, and is more probably artificially created by partial collapse of the vessel. Together with the bending over of the other end of the unit this had produced a fortuitous set of conditions enabling the production of a mass of resin large enough for bubbles to be seen. These latter are clearly seen in the form of a chain or string extending almost the entire length of the element. They are so fairly evenly spaced that, as they appear in the illustration, they might suggest the presence of the typical softwood pitting, but visual examination confirms that they are bubbles.

The point of chief interest in the mass is the very even distribution of the pigment, as is made apparent by the absence of any agglomeration which was so obviously present in the modern material.

The pigment distribution in this material is so even that it warrants further examination at higher magnifications; agglomeration is present on a very small scale, it might then be detected. Another portion of the black material is illustrated in Fig. 397 at a magnification of 2,400 diameters: the field includes the greater part of a wood tracheid section, which is surrounded by the aforementioned matrix of resin and very small wood particles, portions of such typical particles being seen at A, B, and C.

Within the area bounded by the dotted line on the edge of the large tracheid is a mass of resin and pigment relatively free from very small particles of wood, and here it is possible to obtain an idea of the distribution of the pigment. In

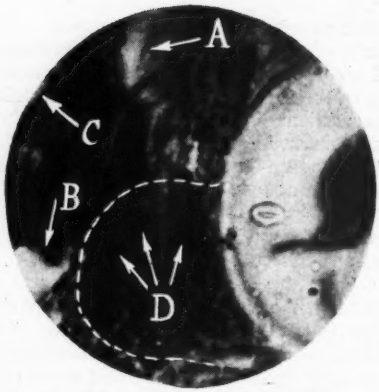

Fig. 397.—Section of old moulding showing pigmentation. Mag. 2,400 diameters.

spite of its density, it is possible to distinguish pigment granules as individuals; at the same time the high magnification shows the presence of three small agglomerates of pigment marked D. These bodies measure some 4 to 6 millimetres in diameter, and are therefore some 2 to 3 microns in diameter, and from the knowledge of the size of the pigment granule it is clear that they are composed of only two or three particles of pigment. Yet it is doubtful whether they are really agglomerates, but merely a collection of a few particles which have become packed closely together as a result of the forces in existence during the moulding cycle.

In view of this it would perhaps be more accurate to class these bodies as being thus formed, in which case the whole mass may be regarded as being free from agglomerates in the true meaning of the term. This is an indication of high quality in the moulding material, and in view of the age of the material (some 22 years) it is interesting to note that more modern materials are not so well pigmented.

Apart from the effects produced by even distribution of the pigment, we have seen that this latter is interfered with by the presence of the filler. Thus, the area

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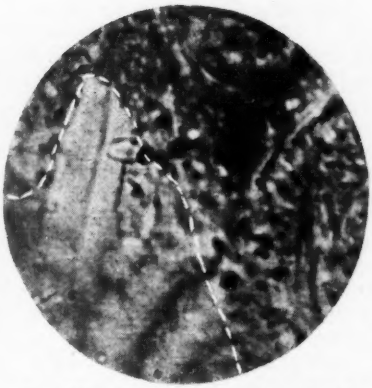

Fig. 398.—Red/black interface of old moulding, showing extent of pigmentation. Mag. 2,400 diameters.

of the section occupied by cellulose may be regarded as being pigment free, and in consequence of this upsetting the distribution, in the case of the material containing a high percentage of agglomeration, the pigments distribution —being initially upset by the filler—is further interfered with by the actual presence of the agglomerates. This not only affects the impregnation of the filler particles, but also the gross structure of the material. On considering the current material, however, we find that the absence of agglomeration leads to excellent impregnation of the wood structure with pigment and resin, and that only in the very fine portions of the structure does filtration occur.

The behaviour of a well-distributed pigment of this type at the junction of two secondary particles is well seen at the red/black interface. It has already been demonstrated that these junctions are very sharply defined in this case, there being very little evidence of any zone of fusion, and in view of the high power examination of the pigmented portion just discussed, it is proposed to examine briefly this interface at a similar magnification.

A minute portion of the red/black interface is seen in Fig. 398, at 2,400 diameters. At first sight there appears to be little to suggest that this is the portion stated, but a careful study reveals the limit to which the pigmentation extends; this is shown by the dotted line. It is unnecessary to emphasize that this line is quite sharply defined when the magnification is taken into account and therefore the extreme sharpness of the interface as seen at low power and by the naked eye, is explained. Nevertheless, in view of this it is natural to suggest that if the particles of different coloured powders keep their individuality to this extent, then the bonding between them may be expected to be somewhat weak and so have a cumulative effect on the general strength of the moulding.

In actual fact, however, the strength of the moulding is quite up to standard, if not a little better, for this type of material, and therefore the bonding of the secondary particles must be adequate. In this case the bond appears to occur in much the same manner as was seen to take place in the case of the two-part powder. The current example will be noticed to present similar features, thus we have a pigmented and unpigmented fraction in each case, the line of pigment limitation delineates the interface. As the pigment suffers little displacement the bond must take place by the fusion of the resin only. This is indicated by the existence of a very narrow zone where there is an intermingling of the colours. The illustration, however, is at too high a magnification to show this, but much the same condition exists at the interface of red and green secondary particles where a distinct "brownish" zone was seen in the colour photographs.

In summing up the information obtained by the examination of this old moulding, the most outstanding feature is the almost perfect impregnation of the wood flour particles in the filler. The reasons for this are not at first sight obvious, for in view of the age of material and improvement in technique which have taken place since it was made, one would expect the impregnation to be considerably less perfect. However, it

is reasonably certain that in these days the proportion of resin to filler used in the mix was higher, in which case a higher mobility—or lower viscosity—in the liquid phase of the moulding cycle would ensue.

In spite of this, the very narrow zones of fusion are an established fact, thereby accounting for the retention of the generally good mechanical properties of the material. Thus, on the one hand, we have indications of fairly high fluidity, by virtue of the fusion; on the other hand, a general lack of fluidity seems to be indicated by the sharp outlines of the secondary particles, which in themselves owe their origin to the tenacity of the fusion zones.

In face of this apparent anomaly there seems to be only one conclusion affording any degree of satisfaction; thus the liquid phase of the moulding cycle must be very short, as otherwise the fusion zones would have been more extensive, giving rise to diffuse outlines to the secondary particles. Whether this was due to a high temperature in the mould or an advance condition of cure in the resin prior to moulding, or a combination of the two, must be left to conjecture. It is probable, however, that the study of the mechanism of heat transfer interference, from particle to particle of the powder during moulding, would throw some further light on the subject.

Assuming that the viscosity in the body of the powder particle is high, it is doubtful whether this could have occurred during moulding, thus pointing to this phenomenon as having occurred on the rolls. If this is so, then it becomes somewhat difficult to explain the small degree of collapse exhibited by the larger wood particles and also the perfect filling of their structures, for these are all indicative of high fluidity and low viscosity rapidly attained, and it is probable that if the resin were allowed to reach the degree of fluidity necessary for this on the rolls, the mixing of the ingredients would become more difficult than usual.

Once again an apparent anomaly is encountered, indicating that the impregnation really took place in the mould. If this is allowed, it may be immediately countered with the existence of the sharp outlines to the secondary particle, which argument, of course, leads nowhere. Therefore one is forced to assume, temporarily, at any rate, and in the absence of evidence to the contrary, that as the heating of the powder in the mould takes place from the outside inwards, and as the individual particles of each fraction of the powder appear to behave as tiny mouldings, each particle is likewise heated from the outside inwards.

On examining this it becomes clear that the peripheral surfaces of the particles will be the first to liquify and set, whereupon the transference of heat to the centre of the particle will become somewhat slower, due to the thermal conductivity of the already cured skin being lower than the liquid resin. Thus the liquefaction of the more deeply situated portions of the particle will not be so rapidly attained and hence the liquid phase will be more prolonged than at the surface and will enable the impregnation of the particles to proceed at a relatively leisurely pace.

Assuming that the mechanism of heat transference through the powder takes place in some such manner, then at least we have a possible answer to the apparently anomalous conditions just discussed. There is, however, no evidence confirming this to be so. Nevertheless, it might be said that if these powder particles behave in this manner, they are in fact duplicating on a very small scale the behaviour of a mass of powder in the mould. It is well known that those portions of mould which are situated at the mould face are always cured first, otherwise there would be no problem associated with uncured cores in mouldings of any great thickness, assuming, of course, that preheating is not resorted to. If the total mass behaves in this manner, there does not appear to be any reason why individual units of the powder should not do so likewise.

(To be continued.)

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., price 1/- each.

B.P. 613,834. Appl. 6.9.45. Conv. (Germany) 10.8.43. Acc. 3.12.48.

Manufacture of Vinyl Esters or Ethers and their Homologues. To: Gevaert Photo Productien N.V.

Production of vinyl esters and ethers (vinyl acetate) from acetylene and acetic acid in the presence of mercury compounds and boron fluoride, adding one or several vinyl compounds in quantities of not more than 3 per cent.

B.P. 613,878. Appl. 6.6.46, 4.9.46. Acc. 3.12.48.

Production of Resinous Materials. L. Dennis. To: Distillers Co., Ltd.

A process for the production of thermosetting resinous moulding materials which comprises mixing the thermosetting resin in granular form as hereinbefore defined with the compounding ingredients and with a weight of water between 1/20 and 5 times that of the total solids, turning the resulting mixture in a grinding mill to effect a more thorough mixing of the solids and a reduction in size thereof and thereafter partially or wholly removing the water from the product.

B.P. 613,880. Appl. 12.6.46. Conv. (U.S.A.) 13.6.45. Acc. 3.12.48.

Polymerization in the presence of Copper or a Copper Alloy. To: British Thomson Houston Co., Ltd.

Coating of copper and copper alloy electrical coils by polymerizing whilst in contact with the metal a polymerizable material containing an accelerator (an organic peroxide).

B.P. 613,931. Appl. 5.12.45. Acc. 7.12.48.

Synthetic Resin Bonding Agents. T. J. Meyrick, J. A. Moyse and E. G. Parry. To: Imperial Chemical Industries, Ltd.

Improved bonding agents comprising aqueous solutions or dispersions of partially resinified heat hardening resorcinol-formaldehyde resins containing a water soluble salt of a sulphuric ester and a monohydric aliphatic alcohol having 8-20 carbon atoms and a monohydric aliphatic alcohol having 6-12 carbon atoms.

B.P. 613,932. Appl. 17.12.45. Conv. (U.S.A.) 13.12.44. Acc. 7.12.48.

Preparation of Resinous Interpolymers. K. C. Eberly R. J. Reid. To: Firestone Tyre and Rubber Co.

Relates to resinous co-polymers of isobutylene and acrylo-nitrile.

B.P. 613,963. Appl. 22.5.46. Conv. (U.S.A.) 22.5.45. Acc. 7.12.48.

Polymerization of Unsaturated Compounds. To: E. I. Du Pont de Nemours and Co.

A process for polymerizing a polymerizable mono-olefinic compound, having the group $CH_2=C<$ the polymerization of which is catalysed by an oxidizing agent in the presence of an oxygen-liberating catalyst, including measuring the oxidation-reduction potential of the reaction mixture and regulating the catalyst concentration so as to maintain said potential within a range corresponding to a suitable range of catalyst concentration.

B.P. 613,977. Appl. 28.6.46. Conv. (U.S.A.) 4.7.45. Acc. 7.12.48.

Stabilized Synthetic Resins. To: E. I. Du Pont de Nemours and Co.

Refers to polyvinyl fluoride stabilized with glycerol monolaurate.

B.P. 613,986. Appl. 16.5.45. Acc. 8.12.48.

Polymer Compositions and the Production of Shaped Articles. J. W. Fisher, E. W. Wheatley and H. Bates. To: British Celanese, Ltd.

Polymer compositions comprising a poly. 1.2.4-triazole and as solvent or latent solvent an alcoholic compound.

B.P. 613,988. Appl. 2.7.45. Acc. 8.12.48.

Melt Spinning of Polymeric Materials. J. W. Fisher and E. W. Wheatley. To: British Celanese, Ltd.

Refers to the melt spinning of poly. 1.2.4-triazoles.

B.P. 614,009. Appl. 16.5.47. Acc. 8.12.48.

Coloration of Yarns or Fabrics composed wholly or partly of Nylon. G. D. Sutton. To: T. E. Marchington and Co., Ltd.

B.P. 614,019. Appl. 17.2.47. Acc. 8.12.48.

Clothes Pegs. R. S. Redfern. To: S. Redfern and Co., Ltd.

B.P. 614,037. Appl. 1.7.46. Acc. 8.12.48.

Manufacture of Condensation Products of

a Phenol, an Aldehyde and Melamine. To: British Industrial Plastics, Ltd.

B.P. 614,063. Appl. 12.8.47. Acc. 8.12.48.
Filament or Film-forming Polymer Compositions. J. W. Fisher, E. W. Wheatley and H. Bates. To: British Celanese, Ltd.

A composition comprising a film-forming polymer having little affinity for acid wool colours and a poly-octamethylene-4-amino 1.2.4-triazole.

B.P. 614,179. Appl. 11.6.46. Conv. (U.S.A.) 11.6.45. Acc. 10.12.48.
Toy Helicopters. B. H. Shapiro, I. Thomas and J. Holt. To: Plastic Parts Development Co.

B.P. 614,190. Appl. 5.7.46. Acc. 10.12.48.
Copolymers of Vinyl Esters with Dihydropyran. N. W. Flodin. To: E. I. Du Pont de Nemours and Co.

B.P. 614,195. Appl. 5.7.46. Acc. 10.12.48.
Doll's Furniture. H. A. Nieboer.

Toy furniture produced by cutting extruded polythene sections.

B.P. 614,198. Appl. 5.7.46. Acc. 10.12.48.
Polymerization of Organic Compounds. H. M. Hutchinson, R. R. Smith and J. J. P. Stadinger.

B.P. 614,214. Appl. 9.7.46. Acc. 10.12.48.
New Condensation Products and their application to Textile Materials. L. Bradford, W. Charlton, E. B. Robinson and C. D. Weston. To: Imperial Chemical Industries, Ltd.

A process for the manufacture of new water soluble condensation products, useful for the production of glazes and/or shrink and creaseproof agents on textile materials which comprises heating under neutral or alkaline conditions, an aqueous solution of formaldehyde with one or more polyureas consisting of three or more groups of the general formula $NRCONH_2$, wherein R is hydrogen or a short chain alkyl group (containing not more than six carbon atoms), said carbons being separated from one another by hydrocarbon chains containing at least two carbon atoms.

B.P. 614,215. Appl. 9.7.46. Acc. 10.12.48.
Polyureas. L. Bradford, W. Charlton, H. Plimmer, E. B. Robinson. To: Imperial Chemical Industries, Ltd.

B.P. 614,244. Appl. 2.5.46. Conv. (Italy) 21.6.44. Acc. 13.12.48.
Apparatus for producing by Extrusion, articles of Thermoplastic Material. To: S.P.A. Lavorazione Materie Plastiche.

This invention relates to an apparatus for the manufacture of strips, bands or the like of thermoplastic synthetic resins of which the flexibility and/or colour vary in the transverse direction of the strips, bands or the like.

B.P. 614,258. Appl. 4.7.46. Acc. 13.12.48.
Teething Devices for Infants. M. E. Storey.

Urea formaldehyde teething device.

B.P. 614,265. Appl. 8.7.46. Conv. (U.S.A.) 9.7.45. Acc. 13.12.48.
New Compositions containing Water-insoluble Organic Polymers and Water-soluble Organic Polymers. To: E. I. Du Pont de Nemours and Co.

Compounds comprising an aqueous dispersion of a water insoluble mono-ethylenic carbalkoxy polymer blended with an aqueous solution of a water soluble interpolymer of ethylene or vinyl acetate.

B.P. 614,269. Appl. 8.7.46. Acc. 13.12.48.
Method and Apparatus for Rolling a Continuous Sheet of Plastic Material with a longitudinal bend superimposed thereon. I. L. Lesavoy.

B.P. 614,281. Appl. 10.7.46. Acc. 13.12.48.
Dielectric and Eddy Current Heating. H. M. Nelson. To: General Electric Co., Ltd.

B.P. 614,295. Appl. 12.7.46. Acc. 13.12.48.
Organic Polycarbamates. W. Baird, P. Gaubert and A. Lowe. To: Imperial Chemical Industries, Ltd.

B.P. 614,303. Appl. 30.5.46. Conv. (France) 26.6.45. Acc. 13.12.48.
Polyvinyl Resin Compositions. To: Société des Usines Chimiques Rhône-Poulenc.

Process for reducing the tendency of polyvinyl resins or compositions thereof to deform or soften under the action of heat which comprises incorporating in the resin or compositions thereof an alcoholate of tin.

B.P. 614,307. Appl. 23.11.44. Conv. (U.S.A.) 22.11.43. Acc. 14.12.48.
Stabilization of Aqueous Anionic Dispersions of partially Polymerized Dimethylolurea. To: American Cyanamid Co.

B.P. 614,358. Appl. 11.7.46. Acc. 14.12.48.
Production of Hollow Articles by Dipping. L. Landau. To: Latex Industries, Ltd.

B.P. 614,389. Appl. 27.7.44. Conv. (U.S.A.) 29.10.43. Acc. 15.12.48.
Preparation of Polysulphide Polymers. To: Thiokol Corp.

Discloses a method of producing polysulphide polymers which have good resistance to cold flow after curing.

B.P. 614,401. Appl. 7.8.45. Conv. (U.S.A.) 15.8.44. Acc. 15.12.48.

Production of Bonded Laminated Materials To: Bakelite, Ltd.

Production of a bonded laminated material by spraying metal on to a sheet of fibrous base, thus forming a porous metal coating, applying to the latter a heat hardenable synthetic resin adhesive, assembling the coated base with one or more similarly coated bases and one or more fibrous layers so treated and heat hardening of the adhesive.

B.P. 614,434. Appl. 12.3.46. Acc. 15.12.48.

Drying Rubber Latex Compositions by treatment with R.F. Alternating Electrode Currents. W. Binus. To: International Latex Processes, Ltd.

Intermittent application of R.F. with plate electrodes. It is claimed that less power is required than would be the case with continuous application where isothermal effect takes place and stops evaporation.

B.P. 614,446. Appl. 2.5.46. Conv. (Italy) 15.5.44. Acc. 15.12.48.

Method and Apparatus for Kneading and Manufacturing Granulated Plastic Masses. To: S.P.A. Lavorazione Materie Plastiche.

B.P. 614,447. Appl. 2.5.46. Conv. (Italy) 28.3.45. Acc. 15.12.48.

Manufacture by Extrusion of large-size Tubes from Thermoplastics, Rubber and the like. To: S.P.A. Lavorazione Materie Plastiche.

B.P. 614,458. Appl. 4.7.46. Acc. 15.12.48.

Manufacture of Expanded Thermoplastic Materials. S. Booth. To: Expanded Rubber Co., Ltd.

Production of an expanded thermoplastic material by submitting it to a heat treatment sufficient to render it plastic (100-120°C.), impregnating it with a gas under pressure without the aid of a plasticizer, cooling the material under maintained pressure, releasing the external pressure and reheating of the material carefully avoiding escape of the gas.

B.P. 614,506. Appl. 17.7.46, 16.12.46. Acc. 16.12.48.

Artificial Filaments, Threads, Bands and the like. A. F. Millidge. To: Courtaulds, Ltd.

Manufacture and production of artificial threads from protein by extruding a protein solution into a setting medium followed by a hardening treatment to render the threads resistant to cold water, stabilizing the protein against hot water and hot dilute acids by incorporation in the spinning solution of sodium or potassium cyanate.

B.P. 614,532. Appl. 19.7.46. Conv. (U.S.A.) 30.11.45. Acc. 16.12.48.

To: Resinous Products and Chemical Co.

B.P. 614,533. Appl. 19.7.46. Conv. (U.S.A.) 30.11.45. Acc. 16.12.48.

Copolymers of Cyclopentadiene and Styrene. To: Resinous Products and Chemical Co.

B.P. 614,538. Appl. 23.7.46. Acc. 16.12.48.

Production of Allyl Derivatives. E. M. Evans and H. T. Hookway. To: British Resin Products, Ltd.

Refers to the production of allyl or beta substituted allyl derivatives of 1, 3, 5-trimethylene trisulphone.

B.P. 614,539. Appl. 23.7.46. Acc. 16.12.48.

Production of Polyallyl Derivatives. E. M. Evans and H. T. Hookway. To: British Resin Products, Ltd.

Refers to resins derived from allyl derivatives of 1, 3, 5-trimethylene trisulphone.

B.P. 614,603. Appl. 18.7.46, 11.11.46, 12.4.47. Acc. 17.12.48.

Moulding Decorative Patterns, Motifs or Symbols from Plastic Materials. A. Chadwick and S. Gair.

B.P. 614,625. Appl. 4.7.44. Acc. 20.12.48.

Production of Condensation Polymers. G. W. I. Sheavyn.

Refers to polyhexamethylene-adipamide.

B.P. 614,697. Appl. 25.7.46 (Addition to B.P. 540,494). Acc. 20.12.48.

Use of High Frequency Electric Fields for Heating. To: British United Shoe Machinery Co., Ltd.

An apparatus adapted for use in the treatment of a workpiece with a high frequency field including an electrode assembly comprising an electrode strip embedded in a support of insulating coils, said assembly having been made by providing an electrode strip comprising a core of vulcanizable rubber-like material having there around a braided metallic covering assembling the strip within a support and securing the strip in place.

B.P. 614,762. Appl. 26.7.46. Conv. (U.S.A.) 26.7.45. Acc. 22.12.48.

Dispersions of Polymeric Materials. To: E. I. Du Pont de Nemours.

Refers to the preparation of copolymers of tetrafluoroethylene and ethylene.

B.P. 614,781. Appl. 29.7.46. Acc. 22.12.48.
New Coating Compositions.
Coating composition comprising polymers of 4–vinylcyclohexene.

B.P. 614,800. Appl. 30.7.46. Acc. 22.12.48.
Extrusion Apparatus. D. C. Nicholas. To: B.X. Plastics, Ltd.

B.P. 614,829. Appl. 2.8.46. Addition to B.P. 585,083. Acc. 23.12.48.
Compositions Comprising Polymeric Materials. H. G. White and W. F. Smith. To: Imperial Chemical Industries, Ltd.
Refers to the use of aromatic triisocyanate modified polyester amides, together with an acetal of polyvinylalcohol for lacquers, adhesives, etc.

B.P. 614,861. Appl. 7.8.46. Conv. (Holl.) 16.1.40. Acc. 23.12.48.
Method and Apparatus for Electrically Heating Materials. To: Philips Lamps, Ltd.
Heating by means of a flow discharge in low-pressure gas-filled spaces. Magnetic field used to extend path of flow discharge.

B.P. 614,875. Appl. 9.8.46. Conv. (U.S.A.) 10.8.45. Acc. 23.12.48.
Dielectric Heating. To: Westinghouse Electric International Co.
Design of electrode system for R.F. heating of cylinders. Rotation of cylinder during heating.

B.P. 614,912. Appl. 22.3.45. Acc. 30.12.48.
Manufacture of Leather Cloth. S. R. Hole. To: The Leather Cloth Co., Ltd.
Process of making leather cloth by coating a textile base with a polymer of vinyl chloride insoluble in toluene but soluble in methyl ethyl ketone and cyclohexanone.

B.P. 614,932. Appl. 11.3.46. Conv. (U.S.A.) 5.4.45. Acc. 30.12.48.
Coated Textile Fabrics and Method of Coating the same. W. Flanagan. To: B. F. Goodrich Co.
Method of coating a textile fabric by applying in the first stage a plasticized copolymer of chloroethylene with an ester of an alpha methylene aliphatic mono carboxylic acid whilst the polymer applied in the second stage comprises predominant polyvinylchloride.

B.P. 614,959. Appl. 12.7.46. Conv. (U.S.A.) 12.7.45. Acc. 30.12.48.
Spinning of Artificial Filaments. To: E. I. Du Pont de Nemours.
Refers to the spinning of yarns and filaments of polyacrylonitrile.

B.P. 614,988. Appl. 29.7.46. Acc. 30.12.48.
Attaching Non-metallic Pliable Sheet Material to Members of Frames of Equivalent Supports. A. Freeman.
Refers to a method suitable for attaching Rexine and Crinothene to tubular steel members.

B.P. 614,991. Appl. 2.10.46. Addition to B.P. 579,340. Acc. 30.12.48.
Use for Polyester Amide Composition for Coating, Impregnating, Adhesive or like purposes. J. G. Cook and J. T. Watts. To: Imperial Chemical Industries, Ltd.

B.P. 614,992. Appl. 2.8.46. Addition to B.P. 581,146. Acc. 30.12.48.
Curing of Polymeric Materials. W. F. Smith, D. H. Coffey and H. G. White. To: Imperial Chemical Industries, Ltd.
Refers to the use of polyester amides modified with organic polyisocyanates other than diisocyanates.

B.P. 614,993. Appl. 2.8.46. Addition to B.P. 580,524. Acc. 30.12.48.
Treatment of Polymeric Materials. D. A. Harper, B. J. Habgood and R. J. W. Reynolds. To: Imperial Chemical Industries, Ltd.
Refers to modifications of B.P. 580,524 by using an aromatic triisocyanate modified polyester or polyester amide.

B.P. 614,994. Appl. 2.8.46. Addition to B.P. 580,526. Acc. 30.12.48.
Curing of Polymeric Materials. D. A. Harper, and H. P. W. Huggill. To: Imperial Chemical Industries, Ltd.
Similar to B.P. 580,526, the modification consisting in using an aromatic triisocyanate modified polyester or polyester amide.

B.P. 615,125. Appl. 26.7.46. Conv. (U.S.A.) 26.7.45. Acc. 3.1.49.
Dispersions of Polymeric Materials. To: E. I. Du Pont de Nemours.
Refers to dispersions of copolymers of tetrafluoroethylene.

B.P. 615,209. Appl. 20.6.45. Acc. 4.1.49.
Improved Moulding Compositions. G. P. Lee. To: Imperial Chemical Industries, Ltd.
Thermosetting mottled moulding composition obtained by blending together a plurality of moulding powders of different colours, each of the individual powders containing a finely powdered metal as a pigment.

B.P. 615,240. Appl. 26.3.46. Conv. (U.S.A.) 26.4.45. Acc. 4.1.49.
Phenolic Alkyd Resins. To: Norton Grinding Wheel Co., Ltd.

Leaves from a Moulder's Notebook

Copies of this article will be sent on request. A further volume containing numbers 13-29 in the series is being prepared and copies will be available at an early date.

This, the last of the present series of 'Leaves', instead of describing one mould or moulding problem, refers to a number of smaller ones. They are hand picked and are of the type of which experience has warned us for years but which we still repeat. They are compiled as a series of " Don'ts ".

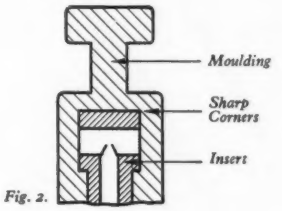

Fig. 2.

If you can avoid it :—

1. Don't design a mould to include horizontal join marks within the mould. If you must do so, use a positive clamp to keep the joint closed (*see Fig.* 1).

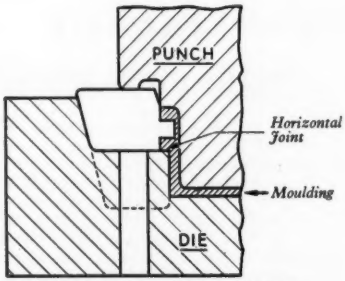

Fig. 1. Dotted Line shows better design of Block

2. Don't leave sharp edges on large inserts (*see Fig.* 2). Cracking of the moulding is likely to ensue.

3. Don't provide double land faces on a mould. If you must do so, as for instance with the threaded die in Fig 3, make sure that ample flash clearance is provided as at 'A'.

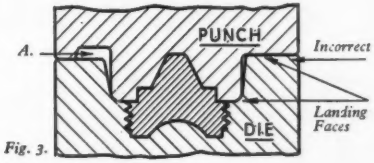

Fig. 3.

Finally, the cavity of a positive mould has no taper and no spue or flash grooves. A positive mould is not an instrument for mass production and to those about to design one, the advice of Mr. Punch is offered—Don't ! However, as a means of solving a difficult moulding problem it may have its uses if designed with care.

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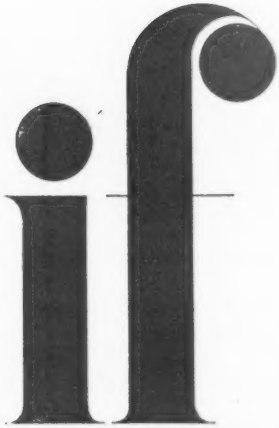

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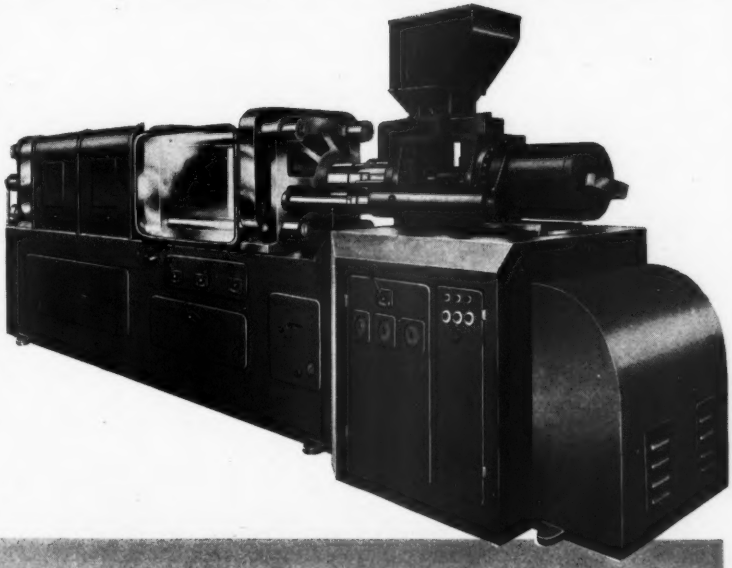

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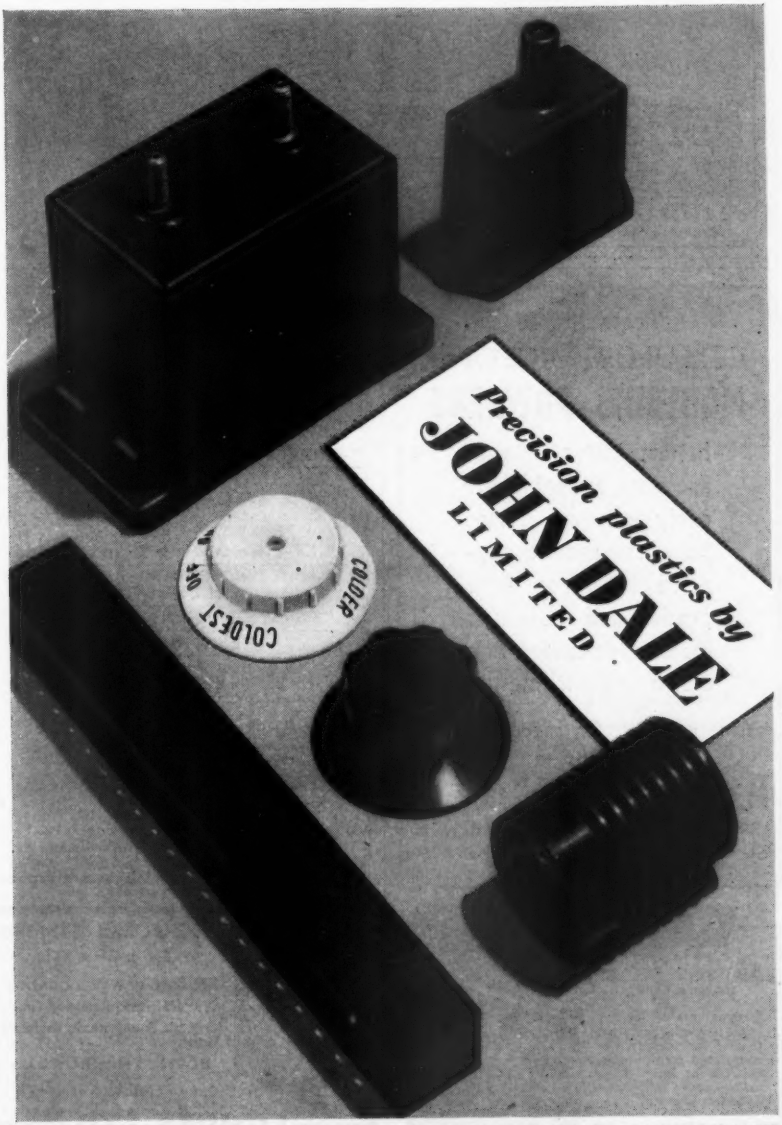

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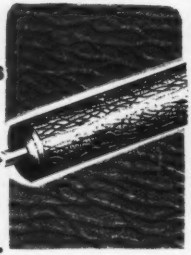

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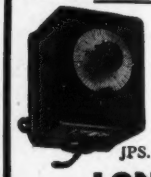

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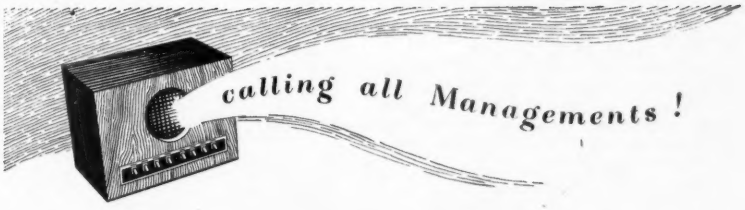

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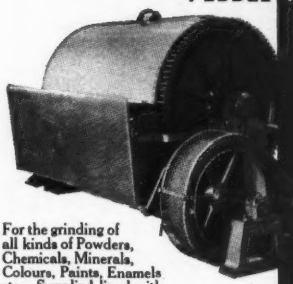

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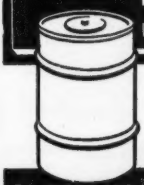

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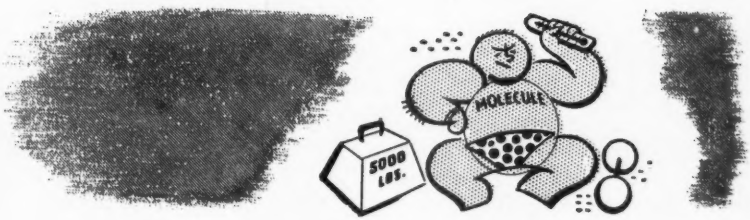

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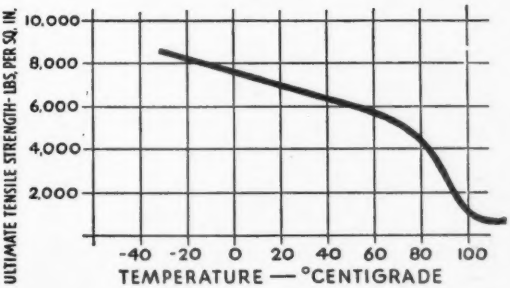

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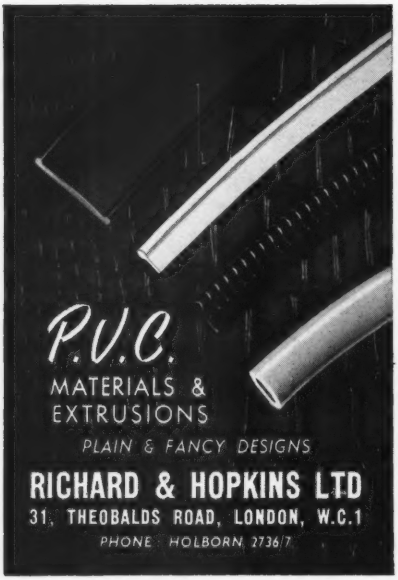
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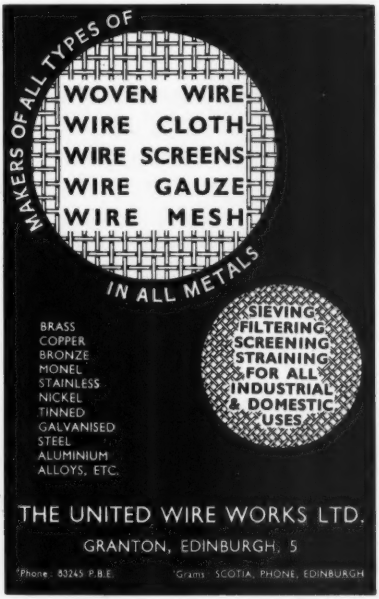
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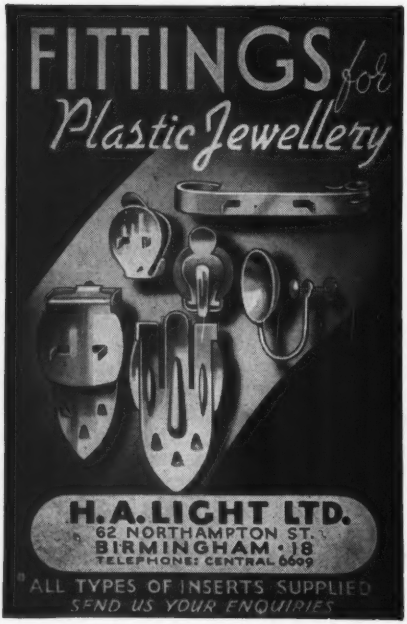
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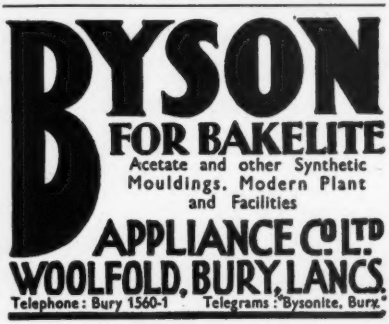
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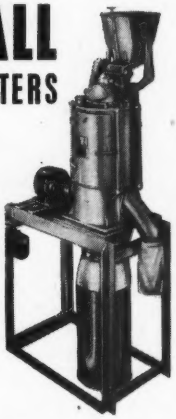

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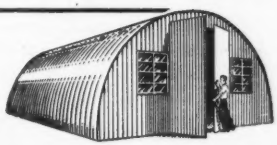

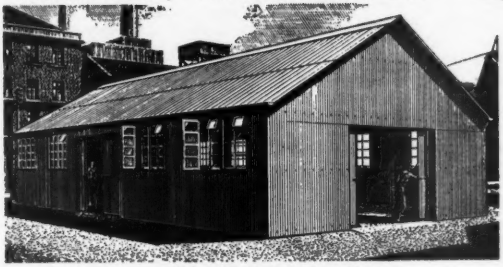

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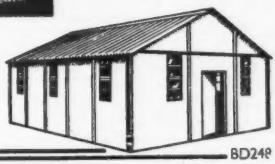

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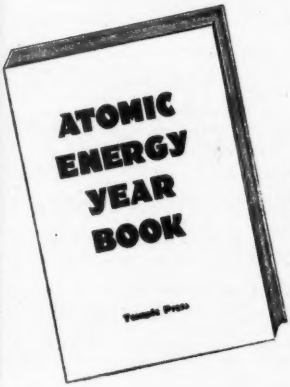

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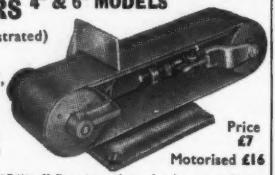

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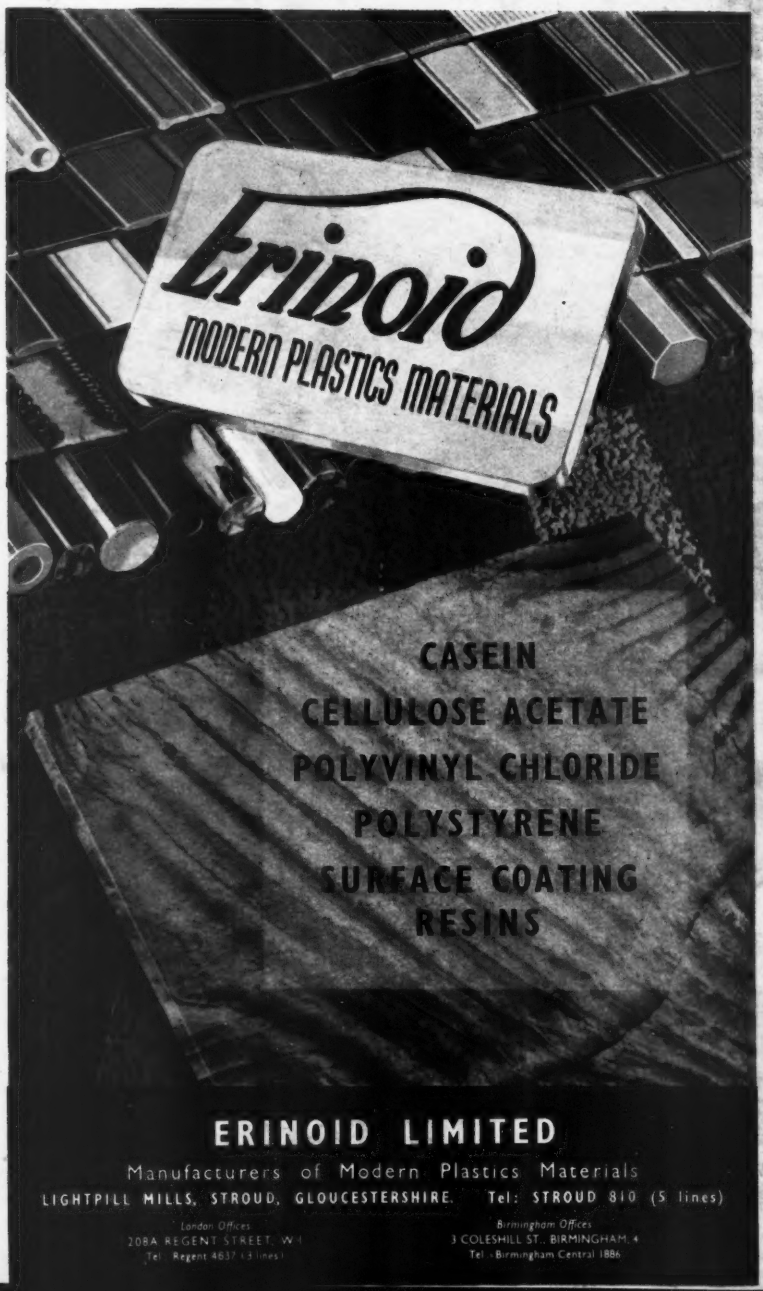

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